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The Conference attracted over 400 students and postgraduates. The publication is intended for scholars, undergraduate and postgraduate students from Ukraine, Poland, involved in research and development work in different fields of science and technology.

The articles compiled in the book are reproduced without editorial interference as they were presented by the authors.

SECTION: MODERN INFORMATION TECHNOLOGIES

PROTECTING AGAINST SOCIAL ENGINEERING ATTACKS

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Keywords: social engineering, cyber attack, cybercrime, hacker, fishing

Introduction. Every year hackers are developing more and more sophisticated methods of social engineering to obtain confidential information about a person or a company. Social engineering attack is the psychological manipulation of a person for receiving the necessary information or data by means of deception (Nate Lord, 2019).

Objectives. The main goal is to prevent deception of people and the maximum possible protection of the weakest point in any institution or organization, namely the human factor.

Methods. There are several possible methods of protection against social engineering. First, distrust any emails that ask for username, password and credit card number information, or emails asking you to click on a link and enter this kind of information (authentic organizations on the Internet do not ask for personal details in emails). Second, when contacting a financial institution, only the official website should be used, most of which use the protocol https. This is good protection against phishing attacks. Third, make sure that you or your information security specialist knows how to handle social engineering attacks, as each attack has its own signature and purpose. Also, the use of software protection, such as: antiviruses, firewalls and anti-spyware to protect against viruses, Trojan programs, spyware and advertising software – is a necessity. Fourth, an organization can purchase insurance against hacker attacks, but this requires clear and well-defined security policies that describe procedures for accessing information.

Results. By studying security practices, that are an important part of the security system, users and employers limit the leakage of sensitive data to both businesses and individuals. These days, social engineering defense educators focus on different attack scenarios and how users should respond to them. Most enterprises are equipped with technical protection against attacks such as spyware, Trojan software, and phishing; the staff is also being trained for the correct behavior when faced with social engineering.

Conclusion. Summing up the study of protection against modern social engineering attacks, we see that this problem poses a rather large threat to the security of confidential information today, so various methods were considered to prevent the possibility of obtaining information by malefactors.

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PERSPECTIVES OF THE SOFTWARE DEFINED NETWORKING

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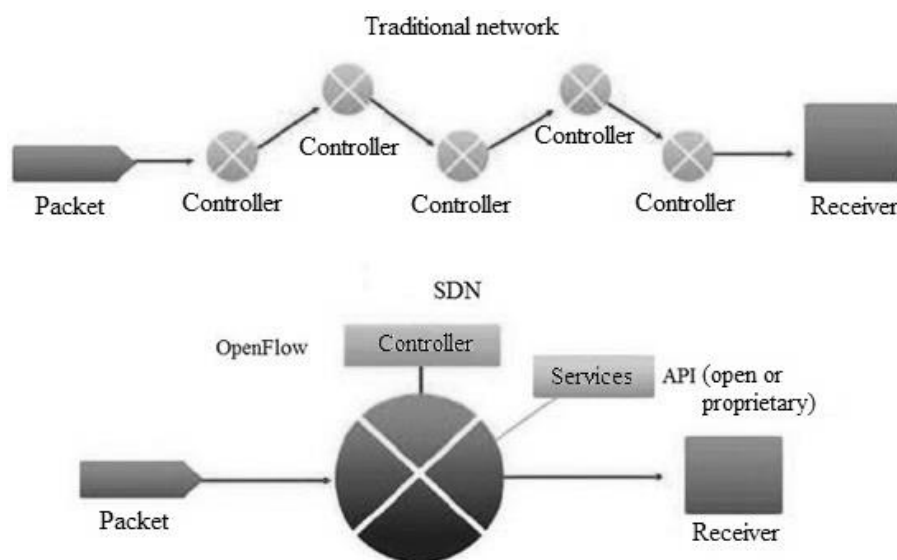
Key words: SDN, Control Plane, Data Plane, OpenFlow Protocol, switch

Introduction. SDN is a network architecture which allows to controlling the network centrally using software. The sense of this approach is to separate Control Plane from Data Plane. SDN will help administrators not to configure every device separately.

Objectives. To show the perspectives of Software Defined Networking.

Methods. The controller becomes the main one: it sees and knows everything and gives instructions on traffic processing to network devices. The appliances have no need to understand hundreds of protocols. They have to follow instructions of the controller which means that they can be simple and cheap. The OpenFlow Protocol, the first version of which was created in 2008, is the first SDN Protocol and is currently the standard for SDN solutions based on open technologies. OpenFlow describes the principles of interaction between SDN controller (Control Plane) and network devices (Data Plane). In traditional switches and routers, these processes are inseparable from each other and are implemented in a "single box": special chips ensure the transfer of packets from one port to another, and the overlying software defines the rules for such forwarding, performs the necessary scanning of packets, performs changes to their service information, etc. To determine the transmission route or prevent traffic looping, devices, of course, "communicate with each other", for which a large number of protocols have been developed.

Results. SDN-based services and applications stand out from the core technologies. The hardware that provides physical connectivity is taken out of a network management. Applications interact with the network via API instead of the management interfaces that are bound to the hardware.



Traditional network and SDN

Conclusion. The transition to SDN provides a lot of economic benefits, including reduction of equipment costs. Since the “brain” of the network device is placed on a separate device, the requirements for the functionality of the network equipment are reduced, requiring only high-speed traffic processing and the necessary amount of resources. This will help engineers to focus on the development of new services removing a lot of routine tasks.

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THE USE OF ARM-BASED PROCESSORS IN LAPTOPS

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Key words: processor architecture, CPU, ARM, instructions, x86

Introduction. The first arm processors began mass production in 1983 by ARM Limited. Nobody took ARM seriously before laptops and mobile phones appeared. Before the advent of smart phones, CPU on the x86 architecture were more popular.

Objectives. The main task of processors on ARM architecture is the introduction of energy efficiency of gadgets through the RISC architecture. First of all, this is necessary to extend the life of the processors themselves, as well as for a positive effect on the environment.

Methods. ARM uses RISC architecture. RISC architecture is simpler than CISC and the lion's share of computation optimizations occurs not at the code execution stage, but at the code compilation stage. This makes automatic code optimization more important during compilation, but less important is execution optimization, which takes a lot of transistor budget on x86 processors. In other words, having the same transistor potential on ARM, you can allocate more resources for executing commands, and less for strapping, that is, with equal technical processes and power consumption limits on ARM, you can get theoretical performance higher than on x86 (ARM Holdings, 2011).

Speaking about what ARM chips are, one should note such a moment as the complexity of the proposed modern mobile systems. ARM is not just one processor. As a rule, it includes: a RAM controller, a graphics accelerator, a video decoder, an audio codec, and optional wireless modules. Such a system is called single-chip. In other words, ARM is a chip on a chip.

Results. The greatest success in achieving this goal has been achieved company Apple. This company has managed not only to develop the mobile segment of ARM processors, but also to begin the implementation of ARM processors in laptops. For instance, Apple has been releasing its line of MacBook based on ARM64 processors

since 2021. Such laptops will lose power to their competitors on the x86 architecture, but they will win in autonomy and energy efficiency.

Conclusion. The differences between ARM and x86 are quite significant. But in these latter days, the line between both architectures has been blurred. ARM processors are becoming more powerful and faster. ARM is good not only in smartphones, it is slowly beginning to conquer the laptop segment. You can already find ARM processors on servers and laptops.

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PROSPECTS OF ARTIFICIAL INTELLIGENCE, AI'S CURRENT STATE AND HOW CAN WE IMPROVE IT

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Key words: AI, artificial intelligence, AGI, RL

Introduction. Nowadays, the words “artificial intelligence” are called a lot of different systems – from a neural network for recognizing and reconstructing pictures to a bot for playing video games and winning professional e-sportsmen. There is a definition of AI – it is “the property of intelligent systems to perform creative functions, which are traditionally considered the prerogative of man” (Belova, 2020). It is clearly seen from the definition that if a certain function has been successfully automated, then it is considered to be artificial intelligence. However, when the task of “creating artificial intelligence” was first posed in 1964, AI meant something different. This goal is now called Strong AI or General Purpose AI.

Objectives. Now there are two well-known formulations of the problem. The first is Strong AI. The second is general-purpose AI (or Artificial General Intelligence, abbreviated AGI). Strong AI is a hypothetical AI that could do everything that a human could do. It is usually said that he must pass the Turing test – be aware of himself as a separate person and be able to achieve his goals. Also, there is such a class of systems as Reinforcement Learning. This is something like AGI, but it isn't universal. They are able to learn and then achieve goals in a wide variety of environments (Legg & Hutter, 2007). But they are still very far from being able to achieve their goals in any environment. Reward is a signal for reinforcement. Usually, in order for RL to do something meaningful, he first needs to make random moves for a while, or look at the moves of someone else.

Methods. It would be good to create an AI that will improve itself. Improve its own ability to solve problems. It may seem like a strange idea, but this problem has already been solved for static optimization systems, such as evolution. If it turns out to be realized, we will be able to get a very powerful AI in a very short time. How to do it? You can try to arrange that the RL part of the actions affect the settings of the RL itself.

Or give the RL system some tool to create new data pre- and post-processors for itself. Let RL be dumb, but he will be able to create calculators, notebooks and computers for himself in order to use them in the most efficient way. Another option is to create a certain AI, in which part of the actions will affect its device at the code level.

Results. At the moment there is only a concept: seed AI is a hypothesized type of strong artificial intelligence (Pearce. D, 2020). Some companies like Consolidated Robotics, Texai, Agiri and Singularity Institute are trying and actively working on creating something barely relative to seed or AGI. But the only result of their work is experimental version of compiler for such an AI. Also, the compiler example, as they say, very limited. It is only single-step and the Seed AI algorithm should be infinitely recursive. As an example, program language compilers are often used to compile themselves. As compilers become more optimized, they can re-compile themselves and so be faster at compiling. Seed AI should do this infinitely.

Conclusion. For now, there are no workable options for Seed AI – even if very limited. Most big companies like Google and DeepMind work mainly with neural network architectures. But one thing is clear – someday world will see Seed AI and it will be a true technical revolution.

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BIAS IN DECISION AUTOMATION

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Key words: AI, automatization, law, medicine

Introduction. There is a growing trend towards automation around the world. Decision making is an important task that needs to be considered. But there is a problem of bias in decision-making algorithms.

Objectives. The main task is to consider various examples of bias in AI decision making and solutions for them.

Methods. Different articles and studies have been reviewed on specific examples of AI bias. The fields of medicine, law, advertising and hiring were considered.

Results. AI bias is an anomaly in the results of machine learning algorithms. This may be due to biased assumptions made during the development of the algorithm, or errors in the training data we provide. These errors may be due to lack of data or cognitive due to human perception fallacies.

In medicine, algorithms for assessing the risks of patients may be inclined, with similar medical indications, to underestimate positions on the basis of race, which in turn leads to the refusal to provide medical programs or to being blocked in the queue for transplantation. Recent research showed that “at a given risk score, Black patients are considerably sicker than White patients, as evidenced by signs of uncontrolled illnesses” which is because “the algorithm predicts health care costs rather than illness”. There are also studies that show how unevenly the geographic distribution of medical data is, and those that address race correction in clinical algorithms.

The use of machine learning in judicial practice and crime detection is also becoming more common. And it also has its own problems and prejudices. For example, an experiment in Israel aimed at training the decision-making algorithm for simple cases showed how real judges can be biased. They found that the two daily meal breaks that judges have divided the day into three separate “decision sessions” and “the percentage of favorable rulings drops gradually from $\approx 65\%$ to nearly zero within each decision session and returns abruptly to $\approx 65\%$ after a break”. Other court biases may include gender and racial stereotypes. The same problem can occur in crime detection systems. Given the task of identifying possible areas of crime or roughly determining possible levels of crime, algorithms can only give higher scores to communities on the basis of race. Moreover, if such areas are given more attention in preference to others, a self-reinforcing pattern can arise.

Advertising is also full of biases. The analysis of 141,063 Facebook ads shows major gender biases, including less credit ads for women, or less housing ads for people, that decided not to disclose their gender identity to Facebook.

There are also many smaller cases of algorithm bias such as hiring or image recognition. A similar problem can arise wherever there is a classification problem. But if we don't pay attention to the data, the algorithm will inherit the existing biases that we have.

Conclusion. To sum up, automation will only grow in the future. But it must be implemented carefully. We need to eradicate human bias in the data we use as much as possible. The main goal is for the algorithm to be less biased than the human. Only then will digital doctors and judges be trusted.

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THE DANGER THAT COMES FROM THE INTERNET OF THINGS

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Key words: The Internet of Things (IoT), connection, botnets of things, device

Introduction. “The croutons jumped out of the silver toaster, a spider’s metal paw picked them up and threw them into the melted butter”, Ray Bradbury described the characters’ breakfast in his novel. When this novel was published in the middle of the last century, this picture seemed quite fantastic, but now it is the reality of today, which is called the Internet of Things.

Objectives. The main task is to analyze such a phenomenon as the Internet of Things, to investigate the presence of such a phenomenon in our life and in modern society as a whole. And also assess the level of security and protection of objects in the process of using the Internet of Things.

Methods. At the research level, the author of this article mainly used such general scientific methods as: synthesis, analysis of the Internet of Things: concepts, structures, practices of use. One of the main methods used in this work is conclusions, in which we try to summarize the advantages and disadvantages of a new phenomenon.

Results. The Internet of Things (IoT) is the integration of any object into a network that uses technology to interact with each other and with the environment without human intervention. The gadget can connect to the World Wide Web or “collaborate” with other nearby devices. So there are systems of “smart” house or a whole “smart” city. Devices that can be attributed to the Internet of Things typically have four distinctive technologies: an identifier, sensors, tools for communicating with other devices, and a built-in computer. The built-in computer is used for processing of all received data and execution of programs.

Despite all the advantages of IoT-technologies: “smart” house, autopilot in the car, “smart” watch on hand, connected to the same “smart” phone, heart rate monitors,

pacemakers, computer vision and image recognition systems check the images of several hundred thousands of cameras and getting to know the criminal on more and more surveillance cameras and more. This is ours today. One big question is, how safe is it? Very often such devices do not have any antivirus or user scan. The device receives an algorithm of actions that it must perform under certain conditions and that lead to the result that is set by the developer and desired for him. Today, trust in the Internet, its security in the EU countries is no more than 40% (Trust in the internet in Europe 2019, by country, 2020). According to the ThreatMetrix survey for the first quarter of 2018 the number of cyber attacks in Europe increased by 30%. That's 80 million attempted attacks on the Internet (5 ways to protect personal data online, 2018) Experts even talk about "botnets of things". A botnet is a network of computers infected with a virus. The virus tracks and transmits to hackers all entered passwords, financial and other secret data.

When a user's device is hacked, personal information about a person is endangered (his location, state of health, photos, conversations can be intercepted, including business ones, which can be used for blackmail, extortion and espionage, etc.). Yes, hacking a SmartTV TV that has a camera and microphone can allow attackers to listen and watch the owner without his knowledge. In the fall of 2017, LG's mobile and cloud applications discovered a vulnerability that allowed them to remotely access this application and gain control over the smart home devices, given the previously mentioned capabilities of this smart home. This poses a great danger to both the resident and the house itself (The hidden threat: the Internet of Things, 2018).

Conclusion. Endless access to anywhere in the world, managing devices that already know all your preferences and health settings, and much more. But do not forget that any technology is created and controlled by man, so your data goes to other people who can use it for their own purposes. However, we can already say that the devices are already controlling us, and vice versa. Connecting ordinary household items to the Internet can bring great benefits to society, but at the same time, will entail disadvantages, so now it is necessary to approach the latest technologies wisely as never before.

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SCIENCE AND TECHNOLOGY OF THE XXI CENTURY

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Key words: machine learning, artificial intelligence, database

Introduction. These days a lot of interesting discoveries in the science region are made every day one of them is machine learning. Particularly, it is well known by the possibility of the computer to learn without being programmed. Furthermore, according to the study this is one of the most technological that one would have ever come across. As it is evident from the name, it gives the computer the capacity to learn, which makes it similar to humans. It is known as a part of artificial intelligence. Basically, they can learn from information, identity and make decision with small amount of human decision. Databases are an important component for this study. If you want to set up the system, you will need to collect data from public resources, or generate new data. All datasets that are used for the development of computer system is combined together to form the database. Mainly, scientists divide data into categories. For example, train, validate and test (Expert system team, 2020).

Objectives. The common interest in machine learning is on account of the same cause that have made data processing in-demand. In addition, stuff like increasing the volume, velocity, different accessible information was a challenge for that time. Fortunately, now computational signal processing is low-priced for keeping information in the memory storage, which makes it implementable. Things like these are making it capable by producing prototype that can scan large, multiple data and deliver them faster. Also, by designing nearly the same models, a company has more possibilities of recognizing beneficial opportunities or keeping away from difficulties (IBM Cloud Education, 2020).

Methods. Different companies are using the process of computing. Namely, financial sector this technology is used for dual-purposes. Firstly, to select the important information in data and prevent swindle. Secondly, it can find out customers, which are exposed to a high level of danger on their profile or use an electronically system for surveillance of online activities to identify warning marks. The governmental agencies, for example, public welfare have a specific demand for machine learning because they have numerous sources of materials that can be gained understanding of a complicated problem. For instance, it also finds out ways to rise up organizations and save money. Apart from is that it can be helpful for detecting fraud and reduce the number thefts.

Results. Machine learning is process that powers many of the services we use today. Starting by recommendation systems, for instance, on Netflix, YouTube to those like Spotify. Moreover, search engines like Google and Fox, social media as Twitter, Facebook.

Conclusion. Above all, machine learning authorizes the investigation of massive quantities of information. It gives faster, accurate outcome in order to identify beneficial opportunities or dangerous situations, it may as well require additional time and resources to train it properly. When machine learning is joined together with artificial

intelligence will compose it even more effective in developing large number of information. I am sure that in the nearest future this technology will be used particularly everywhere beginning from mobile applications services to transportation industry.

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PLATFORMS FOR THE DEVELOPMENT OF PROGRAMMING SKILLS

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Key words: platforms, skills, task, hackathon, programming, middle, network

Introduction. There are many platforms for the development of programming skills, in that you can easily participate all around the world, but also in most of the countries of Ukraine. This is important not only for beginners, but also for middle or senior programmers, as through such events people improve their skills, learn how to work in a team, develop leadership skills, present their project to the audience, and possibly even release it as finished product to the world.

Objectives. The main task is to analyze some international and Ukrainian platforms and events, where people can prove themselves both in team work and individually, solving some tasks and working out their personal algorithms.

Methods. First of platforms is hackathon it is a sprint-like event, where computer programmers and graphic designers, interface designers and other specialists gather in teams, and then together involved in software development to solve some problem from couple of hours to days. The main task of this event is to create high-quality software at the end, it can be for education, society,

Results. IT companies and other. The subject may be different from removing the watermark from the image to creating program, which will solve the information security problems of some company, a browser extension, a neural network that studies how citizens spend their free time etc. In Ukraine, it can be MyHackathon, Blockchain Hackathon, KPI Vision Hack, KNU Hackathon. An example of an international hackathon is the NASA's "Space Apps Challenge", where participants solve practical problems in the study of outer space and environment. Hackathon is a good chance to feel for a few hours what a real technology business is and to understand for yourself are you ready for it. The second one is Global Game Jam (GGJ) – it is the largest international competition in game development. At each location, participants come together in small groups to create new entertaining games on a given theme and present them in general, and they have limited time of 48 hours. Participants of the Global Game Jam may have different skill levels in different areas, but that does not mean that this event is not worth your time. Everyone can take part, from senior game developers to

beginners, artists, QA-engineers and designers. When the jam begins, participants come up with fresh ideas before tell them to each other and forming teams to work together on the project. The themes of past years were “Repair”, “What the house means for you”, “Transmission”, “Waves”, “Heartbeat sound” and so on. The Global Game Jam is the largest game jam event taking place around the world, and, luckily for us, including Ukraine. GGJ is a great opportunity to improve your development skills, imagination and also understand do you really enjoy creating games, and maybe start progress in this field. The third if E-Olymp – it is an Internet portal, created for gifted youth of educational institutions of Ukraine, where they have the opportunity to prove themselves, their potential, improve their skills and prepare for the Olympiads. But you can also solve problems without being a participant in any Olympiads, exclusively for your own development. Tasks can be of varying complexity and different subjects – there are completely simple ones, for example, print prime numbers up to 100, but there are those that are worth your considering. After completing the work, you can check the performance of your program on the tests. The last, but not least, is Codeforces – it is a platform for programming competitions, which regularly hosts tournaments, in which some of the best programmers in the world participate. If you are a beginner coder, the tasks are likely to be too complicated for you. To solve these problems, knowledge in the field of mathematics is required. The goal of Codeforces is to offer developers a convenient platform for creating, conducting and discussing programming competitions. The platform has elements of a social network, it is more than a news portal and more than an online judge. You will be able to independently prepare and conduct the competition. You decide whether it will be open to the whole world or will be a local competition of your university. There are also foreign platforms – CodeFights, CodinGame, GeeksforGeeks and others.

Conclusion. To sum up, there are an incredible amount of opportunities, platforms and events for programmers. They can help both junior programmers to begin their journey in the IT, and more advanced, middles or seniors, to learn something new and keep themselves in “good shape”. In addition to developing specialization, such forums provide an opportunity to try yourself as team-leader, develop oratory skills and learn how to present your product in a good manner. It is also a great opportunity to meet new people, share your experiences and enjoy communicating with people who share your interests. It is also a very effective way to find talent and a new employee in your company!

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HOW YOUR WIFI CAN BE HACKED

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Key words: Wi-fi network, hacking, KRACK attack, security

Introduction. Nowadays people are quite informed about the information security basics, among which are: do not connect to public wi-fi access points, do not share your private information (e.g., credit card and CVV numbers) on suspicious web-sites, do not use weak password to protect your wi-fi router, etc. Furthermore, we may feel safe enough in cyberspace, because the main priority for the IT companies is security of their users, so they are always trying to keep their products up-to-date in order to get rid of zero-day vulnerabilities. But what if our own home wi-fi network, regardless of its password strength, may be vulnerable as well as the information that is transferred via this network.

In 2017 Mathy Vanhoef (imec-DistriNet, KU Leuven) discovered the first method to crack WPA2 protocol without directly brute-forcing password of the access point (Vanhoef, 2017). Till that moment, especially after WEP standard, WPA2 protocol had been considered secure enough, even taking into consideration the Hole196 “vulnerability”.

Objectives. The objectives of this work are: 1) to describe the KRACK attack; 2) to inform users about the problem of possibility of being hacked; 3) to inform users about necessity to keep their devices updated as well as following the news in the field of information security.

Methods. The KRACK attack targets against 4-way handshake (Fig. 1), which gives us an opportunity to prove that we are an authorized client and the access point is actually a real router by exchanging 4 messages. During this process, the key for encrypting subsequent traffic of this session is also set, which happens after receiving the 3rd message. In case something goes wrong with the 3rd message (user does not get it for whatever reason), a protocol provides retransmission of the 3rd message multiple times until the user receives it. As a result, multiple installation of the same encryption key occurs. Consequently, nonce (incremental transmit packet number) and key replay counter are reset and intruder can use the resetting to manipulate (e.g., edit, configure, decrypt, replay, etc.) with data packets.

The attack can be performed through the following steps:

- step 1: the intruder chooses wi-fi network and a specific device (or all the devices) connected to this network;
- step 2: the intruder clones this network on the other channel (in order to avoid conflict);
- step 3: the intruder sends deauthentication packets to a victim, imitating the situation when the key should be updated, forcing the victim to reconnect;

– step 4: at this time original access point (AP) is being suppressed, so the victim's device connects to a fake network, considering it as the genuine one;

– step 5: after abusing discovered weaknesses, the intruder can see all the data transferred between the victim and web-applications.

It is also worth mentioning that almost every site or web-application uses https (secure) connection and it is not a big deal for users when someone imitates their routers. Nevertheless, the protocol can easily be downgraded to http using sslstrip2 utility.

Results. What should be done to prevent the situation described above? First and foremost, it is necessary to update all our devices – both routers and gadgets that are connected to the Internet. Otherwise, users will still be vulnerable to the KRACK attack. At the moment of discovering this vulnerability, current version of Android was 8.0 “Oreo” and all the previous versions stay unsupported (depending on manufacturer).

Table 1 shows the statistics on distribution of Android OS versions for smartphones and other android devices in 2019, which seems quite unsatisfactory, because all those electronic appliances are potentially defenseless. Additionally, users are not paying much attention to routers that are never updated out of the box and usually set up only once when the Internet is wired to the house or office.

Conclusion. To sum up, despite the fact that vendors are trying to maintain their products updated, most users still do not care about keeping their devices updated with the newest software versions.

The next step of our research could be the collection of up-to-date statistics on potentially vulnerable gadgets available for customers in order to estimate the current situation on the market.

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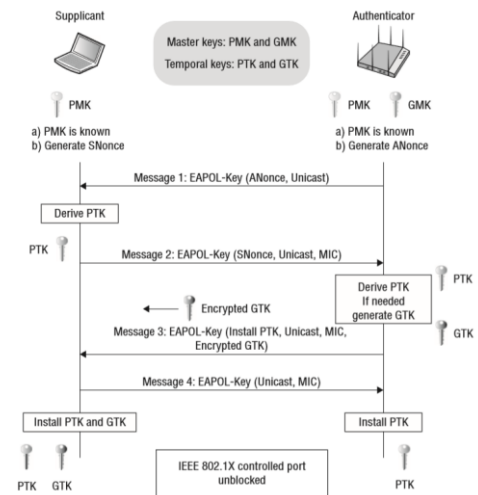


Fig.1. 4-way handshake

Codename	Versions	Share
Gingerbread	2.3.3 2.3.7	- 0.3%
Ice Cream Sandwich	4.0.3 4.0.4	- 0.3%
Jelly Bean	4.1	1.2%
Jelly Bean	4.2	1.5%
Jelly Bean	4.3	0.5%
KitKat	4.4	6.9%
Lollipop	5.0	3.0%
Lollipop	5.1	11.5%
Marshmallow	6.0	16.9%
Nougat	7.0	11.4%
Nougat	7.1	7.8%
Oreo	8.0	12.9%
Oreo	8.1	15.4%
Pie	9	10.4%

Table 1. Distribution of Android OS versions in 2019

DIGITAL VOTING

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Key words: blockchain, digital voting, e-voting, i-voting, security

Introduction. Democratic voting is a crucial and serious event in any country. The most common way in which votes are done is still through a paper based system. So everyone needs to stay in a queue for voting and someone needs to count all the votes afterwards. This opens a huge space for falsification and inconveniences all people involved. The whole process can be improved by implementing a digital voting system. But construction of it is one of the most challenging security-critical tasks, because of the need for finding a trade-off between many seemingly contradictory security requirements like privacy vs. auditability.

Objectives. The aim of this work is to describe a way to provide a good digital voting system.

Methods. One of the ways of solving security issues is through the technology of blockchains. This work describes a blockchain-based digital voting system.

Results. The first aspect of digital voting is verifying a voter. No one should be able to use another person's identity for fraudulent purposes. That means the voter should register before the voting starts. The voter forms a transaction in their blockchain which consists of his personal information (name, date of birth, national insurance number etc.). Once that transaction is created, a voting miner generates a password for the voter and gives them a vote from an infinite pool.

When the voting time comes, the voter needs to provide a kind of identification number (depends on the country) and the password generated after registration. The system then checks their blockchain to ensure that the vote is not used yet. After that the voter selects their vote and it becomes a transaction to a constituency node. That node sends the data to connected peers and the whole network updates.

All of the above steps should of course be secured with asymmetric encryption algorithms so no one could steal any voter's personal data. As well as no one would know which voting option the voter chose.

Conclusion. This work describes a simplified model of blockchain-based digital voting system.

The use of blockchain ensures that no one is able to change voting results. The system also ensures that every voter is unique and has only one vote. So there's less space for falsification left.

With the use of digital voting the people for calculating votes and observing polling stations are no longer needed.

In addition, the voting results can be evaluated and seen live so exit polls are also not necessary.

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ANONYMIZATION OF PERSONAL DATA

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Key words: anonymization, the Internet, personal data

Introduction. Most people wonder why anonymization is so important these days. Today, anonymization of personal data plays a key role in our digital life because of our data usage almost everywhere: in the social networks, in the store, when you pay with credit and bonus cards. However, the most important data we use in our daily routine lives are our personal bank details and medical card details about our problems and illnesses.

Objectives. Nowadays, no one can deny the fact that the value of personal data and its confidentiality is becoming increasingly important. That is why we need to analyze the weightiest issue: “How to ensure the anonymity of personal data of the user on the Internet and protect him from their disclosure?”

Methods. Anonymization of personal data is the process of keeping them secret or turning them into a form in which the identity of the owner of this information will not be disclosed. Anonymization of personal data is the process of keeping them secret or translating them into a form in which the identity of the owner of this information will not be disclosed. There is a huge variety of methods for anonymizing Internet users and their personal data but they all have different levels of anonymity.

After a little research, we can say that if you want to achieve anonymity:

1) a small level. In this case, you should minimize the amount of information you leave about yourself in all sorts of social networks or blogs yourself. 2) medium level, when you have to use a variety of VPN servers, virtual machines, etc.; 3) high level, when you need to use certain temporary e-mails and virtual telephone numbers for registration and what will ensure the greatest anonymity – anonymizers and technical means of anonymization.

Nevertheless, how can we be sure that we have completely anonymized our personal information and ourselves? It is easy. According to the research done by the University of Edinburgh, information is considered to be fully anonymised if there are at least 3-5 individuals to whom this information could refer (The University of Edinburgh, 2020).

Results. The greatest success in this field has been achieved by those professionals who use a whole combination of these methods and rules, combining efficiency and simplicity.

Conclusion. Overall, it may be said that now, with the growing threat of being fully identified on the Internet and the development of deanonymization technologies, new methods of personal data anonymization are being developed and created that allow us to protect ourselves and our data and that is why we have nothing to be afraid of.

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HOW MODERN DEVICES TRACK HUMANITY IN THE 21ST CENTURY

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Key words. privacy, human, device, hacker, special algorithm

Introduction. Today it is almost impossible to imagine privacy. It's becoming increasingly difficult to stay “off the grid”. Whether it is companies tracking their user habits, or the government tracking calls. With a smartphone in a pocket, a sports watch around a wrist, the cloud storing data, everyone has landed in the age of monitoring.

Humanity does not remember all the exact dates, personal vacations, unlike Google. Places visited, period stayed, the Google map may show all these. Even geolocation in smartphones knows and remembers important things. Information can be stored in Google memory for years. Sometimes it helps not to forget about the arrangement, activity, or measure. However, usually it is a terrible story that can be used in opposition to its owner (phone owner). “My Activity” is a site by Google for preserve information about public's activities, so it means that the company knows a lot of secrets evidence everyone in the world.

Objectives. The article's goal is to discover and understand how modern devices track humanity in the 21st century. It could help be more careful with different devices and keep personal data in the future.

Methods. Location data from smartphones are used for various purposes, most frequently for targeted advertising. Companies may show ads for sneakers to people who often go to a gym. Apple and Google use similar information to map and track traffic, or to alert people when stores are likely to be busy. The app makers that sell the data say it allows them to provide their services to users without charging them money.

To collect data about a user, you first need to identify it. To do this the human enough to enter a username and password and leave a trace about actions on another arrangement. Of course, there is a way to log in through a different account and even change appliance from time to time. However, even in this case, there is a way to understand who is sitting at the computer because the user is typing the time between shouts and the typing speed is different for all people. There is already an algorithm that can use this information to determine exactly who is sitting at the keyboard.

Results. The devices can already determine the structure of a skull. Without a doubt, this is everyone's personal characteristic, but it also means that it is a key to obtaining personal information. That is why now in Germany there are glasses that use this property to identify users and such a system Google Glass is embed in headphones or virtual reality glasses and put them on immediately to the user's account. They are absolutely everywhere: speed cameras, red-light cameras at intersections, and even entire surveillance networks dedicated to detecting suspicious activity, monitoring devices.

Google already knows what a person buys on the Internet, but the company decided to go even further, and now monitor purchases in offline stores if paid through Android. The search engine receives data on purchases in physical stores and compare it with the screams of an advertisement. In this way, they are able to understand whether advertising influenced the decision to buy a particular product, or understand what type of advertising to transmit for everyone. iPhone is "smarter" than Google and began collecting multiple photos in folders that can no longer be deleted. Now all secret photos can now be found by anyone who has access to personal phone or email. Everybody knows that phones are already able to recognize a person as an individual.

Conclusion. Even when it seems impossible that it is no Internet these are just a few technology algorithms which hackers use find out special data. To avoid the collection of location data altogether it is better is to evaluate the individual apps on phone to see whether they are collecting more than you would like. It is necessary to deny all applications access to data and allow them to receive only when using the application. It could save personal information veritable confidential in the modern and developing world.

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INTEGRATION OF THE ANTI-PLAGIARISM MODULE FOR INFORMATION EDUCATIONAL PLATFORMS

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Key words: plagiarism, educational platform, cloud computing, anti-plagiarism module

Introduction. Today, the use of modern cloud computing technologies can simplify a huge number of processes in various fields. For example, in the field of education, there are many different learning platforms, and a very large number continue to be created using cloud technologies. They, in turn, allow you to create, store and modify educational and scientific materials, prepare different conferences, or develop educational data archives and journals for publications. However, with the development of technologies, the question arises to automate even more additional but important functions in the relevant learning platforms. One of such important functions is the plagiarism check system in given scientific texts.

Objectives. Identify the need and importance of using plagiarism systems in different educational and research platforms of relevant educational institutions.

Methods. With the development of the Internet, more and more information become available for viewing and for the possible use in new researches of students and scientists. However, due to this high availability of information, it becomes more difficult to verify various scientific papers for originality and borrowing. Today, there are many different methods of checking for plagiarism of text, and they require the use of computer power for research.

Most often, the management of conferences, scientific publishing houses, educational institutions organize a specialized system for evaluating work on borrowings, which has its own algorithm for analyzing the work, and its own database of research already done. However, for those people, who is responsible for this system, there is a lot of manual work, which consists of sending these works for verification and structuring the results obtained, which takes a lot of time and effort. At the same time, the relevant structures already have or are preparing educational platforms consisting of the actual data of students or participants, and may be able to upload scientific or educational work and store it in the data archive, which can also be checked for plagiarism. Building a communication interface between the anti-plagiarism system and the learning platform will easily automate the corresponding verification process.

Results. The development of an appropriate anti-plagiarism module, which will use the mechanisms of the relevant specialized verification systems, will reduce the number of manual works on the organization of publications for their checking, as well as the systematization of results by the percentage of borrowings. A properly constructed anti-plagiarism module will have a user-friendly interface and an algorithm for interacting with anti-plagiarism systems, which in turn will speed up the verification process and minimize manual errors.

It should be borne in mind that each individual learning platform is unique in terms of development tools, as well as the data contained in it, in addition, there are also many different systems of anti-plagiarism. However, this module implements a model that can be adapted to different development tools, as well as integrated with various specialized anti-plagiarism systems.

Conclusion. Nowadays, with the growing amount of information available on the Internet, there are more and more questions arise in the convenient means of regulating borrowing in various scientific publications, and anti-plagiarism systems are designed to help address these issues. However, in educational institutions, where there is a large number of works required for the verification of originality, it becomes very difficult for those people, who is responsible to perform these operations, to send them for checking manually, without having some systematic errors. The construction of modules to check plagiarism based on educational platforms of universities, colleges, etc., allows you to automate this process, which reduces the amount of manual work required to process publications to a minimum, and at the same time speeds up the process of preparing data for further their publication.

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DIFFERENTIAL CRYPTOANALYSIS OF MICHALEVICH-IMAI CIPHERS

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Key words: randomized stream cipher, Michalevich-Imai cipher, differential cryptanalysis

Introduction. Mikhalevich-Imai (MI) ciphers were proposed in 2009 in order to increase the stability of modern stream ciphers. The input data for the construction of such a cipher is a gamma generator and a pair of binary linear block codes, one of which is a subcode of the other. These codes are used for random and subsequent noise-tolerant encoding of incoming messages before their encryption (overlay of the scale produced by the generator), which aims to increase the resistance of the generator to certain attacks (Grishakov, 2018; Rivest, 1983).

Objectives. The results of researches of MI ciphers show that their security significantly depends on the parameters of the codes used to build them, and may be much less than previously thought at the time of their creation. At the same time, the question of the security of MI ciphers with respect to the differential method of cryptanalysis remains open. So, the main task of this work is to show a differential attack on MI ciphers, essentially similar to the classic differential attack on block ciphers, investigate the security of ciphers against this attack and determine which parameters of the component of ciphers (and how) this security depends on (Grishakov, 2018).

Methods. To achieve the main task, the method of theoretical research was applied to a randomized stream cipher. The method of graphical processing of research results and the method of analytical processing of these results were applied to the obtained results of assessments of the security of RSC (randomized stream cipher) against the differential attack and estimates of the complexity of this attack. Linear algebra and probability theory were used to find the results of the research for their further processing (Alekseychuk, 2014).

Results. The report presents a differential attack on MI ciphers, essentially similar to the classic differential attack on block ciphers. The security of ciphers against this attack is investigated and it is established on which parameters of cipher system components (and how exactly) this security depends on (Grishakov, 2018).

Conclusion. The obtained results allow to find out the potential possibilities of MI ciphers in terms of their security against the differential method of cryptanalysis and to formulate appropriate recommendations for the choice of their components.

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ATTENTION ECONOMY IN MODERN SOCIAL NETWORKS SPACE

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Key words: social networks, algorithms, time

Introduction. It's hard to imagine modern world without social media and networks. Modern people tend to spend a lot of time in the internet watching videos, chatting, scrolling through news feeds and so on. Average amount of time spent on the internet is about 155 minutes a day via mobile resources and 37 minutes via desktop ones. So it is obvious that such a big part of our day time must have affect on us as individuals and our society overall.

Objectives. The main task is to conduct research on defining the effect of social media on modern society and ways by means of which companies get profit from their products.

Methods. First let's talk about the structure of social networks. And this will not get very complicated as their name communicates what they are: social platforms that give people ability to perform social interactions between actors (individuals, organizations, etc.). Most of social networks are free to use (more on that later) and easy to enter. And when joining one you get infinite access to opinions of other people, parts of their lives and other content that you will pick for yourself. Sounds fascinating. A tool that can unite people of the whole world on one platform. But as we remember the creators of social networks are huge corporations that do nothing, if they will not get profit. As a matter of fact, they have found ways to make profit from such free platforms for socializing.

Results. The main stream of income for companies is the ability to show adds to users of their social networks, like on TV. But those are not just random adds, they are personally targeted for you by high-end algorithms running on supercomputers. Obviously, such way of targeting adds increases the quality of advertising on the platform by a lot, because more and more people can get interested in those adverts. Also, we should take into consideration that if company wants to sell us anything it probably will. Big corporations have enormous amounts of marketing features that can convince you to buy some kind of product. As you may have guessed all those features and strategies are widely used in internet. So, as we can see social networks are not only platforms for communication but also the greatest advertising machine we have ever had encountered in our history. Also, a very natural thing to implement in social networks are some kind of mechanisms that will make people use platform more and spend more time on it. And there are plenty of such things implemented in modern social media. Facebook will show you post that you will most probably like and agree with, YouTube and Netflix both have auto play and advanced algorithms of analyzing user's preferences and these are only the most effective examples for such mechanisms. One more significant issue is that these corporations are spread worldwide but still remain oriented on English speaking countries. These leads to the situation where in less developed countries (African countries for example) social media lack moderation and become an instrument for fake news. There are stories when people committed social justice based on fake news spread by means of Facebook. Companies just do not have enough resources to moderate the whole world and these leads to tragic consequences.

Conclusion. To sum up, corporations like Facebook and Google base their decisions on the philosophy of infinite growth. These creates a big discrepancy between morality and actions of corporations. Our society still doesn't fully understand the harm that this situation can cause. We still learn to live alongside internet and we still have to come up with methods of regulation and create a moral code that can be applied to modern digital world.

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WILL A ROBOT TAKE OUR JOBS?

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Key words: robotics, food waste, AI, workplace

Introduction. According to industrial revolution, automation's going to replace some jobs, but on the other hand it will definitely provide new ones.

Humans cannot escape of the movement of the industry. Nowadays, we already have machines and robots which do much work for us because it's much more productive. But will it someday take your job and make it much better than you do? That's the problem and it's pretty terrifying for a lot of people. Maybe not yet, but soon it will be relevant.

Objectives. In fact, people are rapidly developing technologies. We don't know what scientists will introduce us tomorrow, but we're able to predict where Machine Learning is going to and therefore we can foresee what it will lead the world to. In effect, what it will lead us to? How it will affect the economics? And will it make us unemployed? Humans need to pay much attention to these questions as fast as possible.

Methods. As far as we're concerned, the way of solving such problems is the way of integration robotics, A.I. technologies and Machine Learning with human skills to provide new jobs. The question is will there be fewer of these new jobs? Of course. For instance, neither television, nor video killed the radio, likewise tractors didn't make farming obsolete. It just provided new opportunities.

People can find the way to make robots work side by side with the humans to be more productive without any threat of losing jobs or reducing the number of workplaces. The automation solves problems such as people can't like gas emissions which are caused by garbage and a food waste. Machine Learning can help society change supply chains, so that they're much more efficient.

The A.I. can manage tasks that a human can't because of the harm they can do to a person. Robots are already implicated into dangerous job. People really need to

develop their brain skills. Let the robots do the physical part like lifting, moving, building etc. Humans, in contrast, must fulfill a range of tasks unrelated to their occupation. The workforce is changing and it needs humans to be guided. On the whole, the main reason to use Machine Learning is making things more efficient, safer and cleaner.

Results. For the foreseeable future, there will continue to be a lot of things that only humans can really work with. To my view, the future work is humans figuring out how to do their job better with the help of machines. As far as we can tell, maybe it's more that we're gaining than what we're losing.

Conclusion. So, the misconception that robots will fully take people's jobs are not that truthful. Fortunately, the A.I. will give rise to industries that never existed and therefore will create new workplaces.

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ARTIFICIAL INTELLIGENCE AS A NEW TOOL OF MANKIND

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Key words: artificial intelligence, people, areas, data, technology

Introduction. Artificial intelligence is an attempt to simulate the process of human thinking with the help of special computer programming. A certain program is created that will allow the computer to analyze a large amount of data, find patterns and repetitive data among them and draw conclusions based on them. Using this technology can be very useful for people because we can't analyze very large amounts of data so quickly. Therefore, the creation of such technology will significantly accelerate progress, because in our time, computers have been able to match the human brain or even surpass it. If people continue to work on the modernization of computer technology, in the near future they will be able to create a supercomputer that they can force to work for the benefit of mankind. People have always been able to make up for their shortcomings with their brains, but now is the time when a person is limited by the capabilities of their brain. Therefore, the creation of such an artificial brain, the limitations of which can be determined by humans, is the best way out of this situation.

Objectives. This topic is very important because it concerns a very important and powerful tool that can change the lives of all people. Therefore, it is necessary to determine in which areas artificial intelligence is already used and in which areas it can be most useful.

Methods. In order to make artificial intelligence suitable for use in a particular field, you need to collect all the data related to it. Then you need to let him read this data and find patterns in them and draw conclusions. Then artificial intelligence, when it needs to give an answer, will use these data and conclusions and will be able to give the correct answer based on them.

Results. The most important areas in which artificial intelligence can be used are medicine and education. In medicine, artificial intelligence is used to make drugs and diagnose various diseases. In education, this can be used to develop the most effective teaching methods and train the best professionals (McArthur, D., Lewis, M., & Bishary, M. 2005). Their use in the manufacture of drugs and the diagnosis of diseases are associated with the payment and analysis of large amounts of data (Mak, K., & Pichika, M. R. 2019). For drugs, it is necessary to determine which active substances cure the disease, how to synthesize them and make them act in the right place. To diagnose diseases, it is necessary to identify and compare the patient's symptoms with the diseases that could have caused it (Hogarty, Mackey, & Hewitt, 2018). Also, artificial intelligence can be used not only to produce what is based on human knowledge, but also to develop new knowledge and inventions. It can also help come up with new ways to improve artificial intelligence to increase its efficiency, accuracy and speed of response.

Conclusion. So, artificial intelligence is an incredibly useful invention that is promising, it can be used in any field. It is our ability to go beyond our brains, which in turn will allow us to create things that are beyond our comprehension. Also, artificial intelligence can be used in everyday life to ensure a comfortable life for humans. This will allow people to concentrate on the most important tasks and not waste their time on cleaning, cooking, etc. If this succeeds then people will be less distracted and have less hassle. This will allow us to study a variety of issues in more depth and find the best options for solving problems. In any case, artificial intelligence as a tool will give us new opportunities and therefore its development and improvement should become one of the main tasks of mankind.

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NIGHT MODES IN PHOTOGRAPHY

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Key words: AI, data science, photography, physics

Introduction. Today, mobile photography is a part of the modern world of creating content every day, every hour and every minute. But what’s wrong if we take a shot in the night, for example, astrophotography? I can tell you – the black photo that you can’t recognize. But data science and different algorithms for taking photos can help us in this really interesting hobby.

Objectives. In this article, I’d like to tell you about computer science, namely, using technologies of Data Science, artificial intelligence in night photography.

Methods. Why Data Science can help us in night photography? Let’s get to know about computational photography.

You have probably heard of “Night Mode”, “Night Sight”, “Bright Night”, or other similar terms that describe different night algorithms for taking better photos. We will name all these methods – night mode.

Night mode is a bit complex to understand, but it works similarly to the HDR.

HDR – High Dynamic Range. It is a technique used to balance illumination levels across a photo. It’s a technique for taking a photo in with very different lights level in the scene, for example, sunset. In additionally to HDR, night modes use a higher level of ISO – is a film sensitivity to light and slower shutter speed – the time the sensor is exposed to light. But these parameters bring a higher level of light to the photo but with a higher level of grain. If we were to simply increase the ISO, the photo would come out either too dark, too noisy, or too softened. Unless you go with a long exposure shot, which requires taking the image over an extended period of time, in which case you need to keep the phone very stable.

At first, your phone uses artificial intelligence to detect and recognize a scene that you are trying to photograph. Phone use three main parameters – light, phone’s movement, and the movement of objects being captured.

At the second, then after that phone take many photos with different parameters(ISO, shutter speed) and send all these shots to the next step – computational photography.

Computational photography is more specifically a discipline involving calculations, analysis, manipulation of imagery using algorithms rather than optical methods.

Top using of computational photography:

- Portrait Mode
- Image Enhancing
- Night mode

We can now shoot incredibly high-quality pictures in different scenes and lights without the need for bulky camera equipment.

This step is very important in the process because the chosen algorithm connects all taking shots in one by using different methods like noise reduction, dots fix, sabre, etc.

And then after that, we get high-quality low-light scene photo. This step makes computational photography looks like magic but it is math, programming and different algorithms.

Results. This method of creating photos can be used in different ways and unions. Of course, we have a big amount of other algorithms developed by other companies – Samsung, Google, Apple. But the main idea of all these algorithms is very similar to described above. All of these ways of post-processing photos are really cool for us – users. Because we can take much better photos and view cool content that we can't create before.

Conclusion. In conclusion, I would like to say that math made our world better with technologies given by programming. But we can improve these technologies like night mode by recreating existing algorithms and creating new.

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REDUCING VIDEO CONFERENCING BANDWIDTH WITH ARTIFICIAL INTELLIGENCE

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Key words: artificial intelligence, video conferencing, network video bandwidth usage reduction, generative adversarial network

Introduction. With the increase of video conferencing involvement in our daily lives due to the relocation of working and studying places to our houses, the daily generated global Internet traffic has seen a drastic increase in quantity. Despite the fact that video conferencing comprises a significant portion of this traffic, its quality leaves much to be desired, as it suffers greatly from poor Internet connection or limited bandwidth. An approach for video quality improvement by the means of dramatic reduction of bandwidth being used with the help of artificial intelligence (AI) was proposed in order to improve the user experience during video conferencing.

Objectives. The main objective of this paper is to describe an innovative technology of video traffic encoding structure that aims to significantly improve the resulting video quality while also reducing the bandwidth usage. This is achieved with the help of a new SDK developed by NVIDIA called Maxine.

Methods. Bandwidth consumption reduction is primarily achieved by utilizing a different content of data stream being transmitted. Instead of transmitting the video stream comprised of millions of ever-shifting pixels each frame, the system first sends a reference image of the caller along with information describing the location of key facial points around the caller's eyes, nose, and mouth. All the subsequent packets need only contain the updated positions of the key points that differ from the last frame. Thus, there is a single main data structure that describes the key features of the caller, with many additional small packets that correspond to the differences between the consecutive frames.

In the next step, a generative adversarial network (GAN) comes into the process on the receiver side and using the reference image and the key points reconstructs the frames to produce a normal video stream.

Results. Transmitting the key points of the caller's face rather than full images gives the opportunity to effectively remedy the situation and reduce video bandwidth usage down to one-tenth of H.264.

Moreover, the implementation of such AI-based algorithm enables further video quality optimizations including, but not limited to, the following: filtering of common background noise, translation in real-time, and 'virtual assistant' for making notes and answering questions.

Conclusion. The described above technology allows for a good-quality video conferencing user experience in spite of potentially slow Internet connection and limited bandwidth. This area of technology will see even more improvements with the development of AI.

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ORGANIZATION OF DATA RECOVERY WHEN STORING IT IN THE "CLOUDS"

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Key words: clouds, remote storage devices, data block recovery, linear transformations, data backup

Introduction. The emergence of cloud technology has radically changed the way long-term storage and dissemination of information.

The growing number of users has a number of advantages, such as rational and efficient use of resources, flexible system configuration, and quick change of settings as needed, despite a number of disadvantages: dependence on Internet speed, openness to third parties, low efficiency of data access.

Reliability is an integral part of storing data on remote media. Hence, there is a constant improvement of methods and techniques to ensure high reliability when using

remote services. However, it is necessary to take into account the possibility of damage to information due to attacks by attackers, physical destruction of servers during natural, political, or military cataclysms.

To increase reliability, the information is broken into parts and stored on various remote media. Recovery of lost information is due to intact parts of the data. One of the methods by which recovery is possible is redundancy. Backup efficiency is achieved by balancing the reliability of data storage, the speed of data recovery, and the amount of backup information.

Objectives. The main task is to increase the efficiency of data recovery through the use of a minimum number of backup blocks, which guarantees the reconstruction of lost data with given limits on the number of lost blocks using linear transformations that provide high speed and ease of implementation.

Methods. In practice, the technologies of duplication and backup of data implemented within the family of RAID systems have become widespread. Implemented in RAID-1 and RAID-2, individual and group data duplication requires significant amounts of memory and does not guarantee the possibility of data recovery in case of loss of even two blocks (provided that they duplicate each other) (Mortuza and Kuijper, 2011).

Redundancy involves the formation of redundant blocks through functional transformations over information blocks. These transformations can be terminologically divided into correction and recovery codes. Classic correction codes, such as Heming's codes, Reed-Solomon's codes, provide two implementations of two functions: localization of lost information and its recovery. Modified Cowchi-Reed-Solomon codes are used to recover lost data in RAID-6 (Mortuza and Kuijper, 2011).

However, the use of correction codes to recover data blocks during their spaced storage is inefficient due to the fact that in most cases of block loss, their localization can be performed much easier. Therefore, it is more efficient to use specialized erasure codes. The solutions created so far mainly differ in focusing on various factors of redundancy efficiency (Duursma, 2019).

In particular, the amount of backup information used for recovery is often the dominant performance criterion. Relevant solutions are proposed in (Li, Tang and Tian, 2018). However, the use of MDS codes significantly complicates the recovery process and, consequently, has the effect of slowing it down. This limits the scope of effective application of such solutions by restoring 1-2 blocks. It is more efficient to use linear transformations, which are much simpler, to form reserve blocks. In (Markovsky and Velykyi, 2015), methods based on linear transformations are proposed, which allow to accelerate the recovery process due to the formation of diagonal sums of spaced data blocks.

The disadvantage of such solutions is the need for a significant number of backup units. In addition, solutions (Bardis and Markovskyi, 2017) are effective only if spaced at least a hundred blocks.

To eliminate these shortcomings, it is necessary to develop a redundancy scheme that would combine the use of linear transformations with the minimization of the number of reserve blocks with given limits on the number of lost blocks.

Results. The result of the study, aimed at improving the recovery of data stored on remote servers, was the development of redundancy using linear transformations using a minimum number of backup blocks, provided that the number of lost blocks (main and backup) does not exceed three.

Conclusion. The organization of data redundancy with the use of linear transformations with the help of the minimum number of reserve blocks is developed, provided that the number of lost blocks (main and reserve) does not exceed three.

The results of research can be used to increase the reliability of long-term storage of user data in cloud storage.

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LOCAL AND TABOO SEARCH ALGORITHMS FOR RECTANGLES PLACEMENT TASKS

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Key words: placement, local search, taboo search, cutting problem

Introduction. Problems of geometric placement of objects are used in various fields: production planning, placement of fire-hazardous objects, textile industry, etc. Problems of geometric placement can be classified according to Dyckhoff (Aarts, Aarts, & Lenstra, 2003), depending on the shape of the objects being placed, the plane of placement, the directions of placement and additional restrictions.

Objectives. Set consisting of N rectangles $A = \{a_1, a_2, \dots, a_N\}$, which must be placed on a semi-infinite tape consisting of K equal in width levels, at each of the levels we have the maximum number of forbidden zones (holes) – M .

Methods. The local search algorithm is based on improving the existing result by reviewing other possible solutions in the neighborhood (Dyckhoff, 1990). Consider the local search algorithm for the presented problem. To apply this algorithm, it is necessary to construct the initial arrangement of rectangles on a semi-infinite tape. The initial placement of the rectangles is random. Next, we need to consider all possible permutation options that could improve the current solution. If such a permutation is possible, choose it as the best solution. To complete the algorithm, one of two conditions must be met: the locally optimal solution is obtained, or the limit of the given time resources is exhausted. In each iteration, two levels are chosen, and when exchanging rectangles, it is necessary to analyze whether the best solution has been obtained, or the placement option without deteriorating the CF. If this is done, then remember the selected solution as the best and move on to the next iteration. If not – choose other levels and repeat the algorithm again (Glover, & Laguna, 1998).

Here is the pseudocode of the local full exchange search:

- procedure local_search_FE;
- construct the initial placement of the rectangles and define it as the initial solution;
- while the solution is not optimal locally, or time resources are not exhausted do;
- choose any two levels;
- exchange rectangles at selected levels;
- if the current result is better than the solution then take it as the solution;
- return solution;
- end.

Results. The disadvantages of the algorithm include the fact that there may be looping and/or repetition of the considered optimums. To avoid the formation of previous solutions, it is advisable to use a taboo search algorithm. The problem of placing rectangles on a semi-infinite band with forbidden zones was investigated and algorithms for its solution were presented. The local full exchange search algorithm increases the study environment by completely rearranging the rectangles from the selected levels. Using different rearrangement methods, it is possible to obtain permutations with the best CF values.

Conclusion. The algorithm took over the problem of the local search algorithm – looping. In order to reduce or avoid loops in local search algorithms, a taboo search algorithm is used.

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USAGE OF CLUSTERIZATION METHODS FOR DETERMINING THE AREAS OF ACTIVITY OF CANDIDATES IN THE SELECTION OF PERSONNEL FOR IT-COMPANIES

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Key words: candidate, recruitment, clustering, curriculum vitae

Introduction. Today, the selection of candidates for recruitment from a wide range of candidates is a fundamental issue. Traditional methods of recruitment are individual tests and various technical qualification tests, interviews and group discussions. Identifying a candidate's abilities through interviews is a traditional practice in the hiring process (Rout et al., 2019, p. 1856).

Today's Human Resources (HR) managers have to handle extremely large amounts of data: portfolio research, social media screening, skill set identification, and, most importantly, Curriculum Vitae (CV) research. There is a need to extract relevant information from the resume and store it in a database to make data processing easier. In addition, resumes vary in format and style, making it difficult to maintain a structural repository that contains all the necessary information.

Objectives. An objective was set: to substantiate the expediency of models to which the researched problem situations are reduced and to justify the chosen methods.

Methods. In the task of determining the areas of activity of candidates in recruitment for IT-companies an input information is summarized in text form, which contains all the information about the professional career of the candidate, as well as cover letters, essays and career guidance tests with open answers.

An output is a set of professional areas of activity of candidates with the best resumes selected for them, there is a grouping of input data to certain areas of activity.

It is suggested that text clustering methods can be used to group and combine input data. So, clustering methods are considered.

Clustering is the division of a set of input vectors into groups (clusters) according to the degree of "similarity" to each other. In order to be able to compare two objects, there is a need to have a criterion on the basis of which the comparison will take place. Typically, this criterion is the distance between objects (*Clustering in Machine Learning*, 2020).

The c-means algorithm is used for clustering in the system. The c-means algorithm is a modification of the k-means method. C-means is a fuzzy method. Fuzzy algorithms match each object with a set of real values (numbers) that show the degree to which the object relates to all clusters. That is, each object belongs to each cluster with a certain probability. So, all resumes will have certain probability of belonging to specific cluster.

Results. System with analyzing candidate's CVs will allow the Human Resources Department to publish vacancy announcements with job requirements, so that the candidate can upload his/her CV, and system will provide recruitment staff with a set of

resumes that are suitable for a particular vacancy. The system aims to reduce the time and effort of the human resources department in the resume selection process.

Conclusion. The application of clustering methods to the analysis of resumes and motivation letters of candidates makes it possible to determine a set of professional areas of activity of employees with the best resumes selected for them, which means grouping an input data in the form of resumes to certain areas of activity. The considered clustering algorithms are quite simple, easy to implement and are showing a fairly high quality of work.

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ARTIFICIAL INTELLIGENCE EXAMINATION

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Key words: AI, tests, predictions, Turing test

Introduction. How could people divide technology into simple mechanisms and artificial intelligence? A lot of scientists tried to answer this question so they suggested different ways to test AI. So, I want to sum up all of theme and make a simple predictions.

Objectives. The main task is to conduct research for having a full view of AI assessment. If we can understand, how AI can be improved in the nearest future and which conditions should it satisfy.

Results. . He invented a simple game in which a person had a text conversation with unseen players and evaluated their responses. Based on the answers to the questions, he must determine whom he is talking with: a person or a computer program. The task of a computer program is to mislead a person by forcing him to make the wrong choice. Turing predicted that by the beginning of 21st century, computers with at least 100 megabytes of memory will easily pass the test, but he was wrong. Considering that today`s computers have much larger capacity of memory, only a few have succeeded. “Those, who have done well focused more on finding clever ways to fool judges more than using overwhelming computer power” (Gender, 2016, 1:30).

The first program which succeeded was called ELIZA. It had short and simple script, but it managed to mislead everyone by pretending it was a psychologist, motivating them to talk more and making them answer they own questions. Another early script PARRY took the opposite approach: it imitated a paranoid schizophrenic, but it also worked perfectly. The most recent script, Eugene Goostman, was acting like a 13-year-old Ukrainian boy, so his awkward grammar and strange answers could be interpreted as language and culture barriers.

This is the most famous way to determine if a machine has intelligence, but modern scientists have an opinion, this test isn't relevant anymore.

Cognitive scientist Gary Marcus is an active critic of the Turing test in its current form. This year, for example, he organized a conference on artificial intelligence, where he called for leaving the Turing test and coming up with something new. Marcus proposed his alternative, which was described in The New Yorker magazine article. He suggests creating a computer program that could watch television shows and videos on YouTube and answer questions about their content – for example why Joffrey Baratheon ordered the execution of Edward Stark, which isn't so difficult. Marcus's test goes even further: he suggests to include the Simpsons episode in such a program and let it explain where you should laugh. If a computer can determine and understand humor, sarcasm, and irony, it means that it is as close to intelligence as possible, and maybe possesses it.

There are several tests that are oriented on creative and matching skills. For example test of Lovelace. Ada Lovelace said that creativity is a true sign of intelligence. This thesis is based on the original description of the 2001 Lovelace Exam. Mark Riddle added the conditions of the exam, so the assessment would be fair. According to the description, the computer must create smth. (painting or literary work) in addition to the predefined criteria. Among the criteria may be a description of a character with certain characteristics or a description of the plot. In this case, judges should not evaluate the artistic/aesthetic value of the work, but only if it satisfies all criteria.

The last type is the test which verifies the visual abilities of the machine. They show machine a picture and ask, for example, where is the cup and give several answers. All answers are correct (on the table, on the bedding, in front of the chair, to the left of the lamp), but some of them may be more "human like" than others (a person will most likely answer "on the table" for example). This seems to be a simple task, but in fact, the ability to describe where the object is about other objects is an essential element of the human mind. A lot of nuances and subjective judgments play a role here, from the size of objects to their role in a particular situation – in general, context. People do this intuitively, and algorithms usually don't cope with such tasks.

Conclusion. So, after analyzing all mentioned, we can conclude that almost all existing tests are intended to test skills equivalent to the skills of a 5-7-year-old child (orientation in space, the ability to tell smth, answer questions, create pictures, etc.). Considering that AI can surpass a person in analyzing data, collecting and storing information, and in many other things that rely on the system and Template. But it won't surpass human skills that require the ability to create and invent.

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MODERN APPROACH TO UNCERTAINTY IN INFORMATION TECHNOLOGIES

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Key words: linguistic variable, uncertainty, compatibility function, fuzzy set

Introduction. From the beginning of computerization era people are trying to deal with uncertain kind of data, information, that can't easily be perceived as true/false statement. With common binary approach to computation it is very hard to analyze and use this kind of data.

Objectives. The main task is to conduct research on one of the best methods of handling such uncertain and vague information – fuzzy logic.

Methods. Main method of dealing with problems of uncertainty is to connect each vague or uncertain object with corresponding linguistic variable. Linguistic variable as by Lotfi Zadeh is "a variable whose values are words or sentences in a language". For example, as to somehow mathematically define connection between different linguistic variables, compatibility function is introduced.

Results. Compatibility function is a type of function, which use one linguistic variable as main and compares it to its arguments, having value between 0 and 1. As for example, we have linguistic variable $A = \text{"funny"}$. It would be main variable of our comparison function $f(x)$. Now when we will try to pass as an argument other linguistic variables, function will tell us how much different those two variables are. For example, if we have $B = \text{"sad"}$, $f(B)$ will equal 0 as B is the opposite of A . But with variable $C = \text{"not too much funny, but not sad either"}$ $f(C)$ will equal approximately 0,5 because connection between A and C is not strong enough for function to be 1, but also these two phrases are not different enough for function to be 0. This kind of function naturally leads us to expand modern set theory. As we know, in classical set theory we have a concept of member function, which tells as whether element is included into set or not. Changing this kind of function to our compatibility function will lead us to redefining concept of set on more complex situations. For example, we want to describe set of all the funny people. When we have people, that are 100% funny or 100%, it is easy to say, whether they are included in our set or not. But when we have the person that is "pretty funny" or "not so much sad", it is really hard to say, whether we should include them or not. That's why, using the value of corresponding compatibility function on our linguistic variable, we can say that this kind of person is 50% included in set. That's how concept of fuzzy set is being introduced. Fuzzy logic notion is really close to both of the already introduced concepts. Fuzzy logic is redefining basis of binary logic, introducing in addition to "true" and "false" statements other kind of logic variables, that are not binary at all, called linguistic logic variables. For example, statements "more true", "less false", "more true than false" and "more false than true" in addition to standard "true" and "false" are linguistic logic variables. Using these concepts, most of operations of formal binary logic could be redefined to meet the needs of complex systems with big factor of uncertainty. As a result, we defined a system of concepts and

definitions which, using modern computational technologies, may change the world of data processing forever. Using specific technics of fuzzy logic, even absolutely non binary entities from our world can be easily analyzed and integrated in modern technological world. As those concepts are just expansion of all the standard concepts of computation theory, as well as they're really simply understandable, this approach of dealing with vague and uncertain information could be used not only in IT industry, but also in pure science as there are many interesting physical, biological and chemistry objects in our world that couldn't be so easily described with standard approach.

Conclusion. To sum up, method of fuzzy logic and linguistic variables is nowadays the best of all methods of interacting with uncertain kind of data providing effective methods and easily understandable concepts to be integrated in any kind of complex system without much expenses and complications on the way of integrating all kind of entities no matter whether they could be described in binary way or not.

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5G NETWORKS

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Key words: network, transmission, frequencies

Introduction. 5G is a new, fifth-generation wireless transmission technology that will replace the existing 4G in order to improve the quality and speed of information transfer.

Objectives. The main objective of the 5G introduction is to improve the quality and speed of transmission as well as the number of connected devices, which will give an impetus to the production of new innovative products with a wider range of possibilities.

Methods. Like its predecessors, the 5G network uses a system of honeycomb sites, dividing its coverage area into sectors and sending coded data over radio waves, where each cell must be connected to the backbone network via wired or wireless reverse connection.

5G will use an encryption system called OFDM, which already exists in 4G networks, but in the new generation an improved radio interface. It is designed in such a way as to increase network flexibility and reduce the delay time in the network, so that by operating on the same waves as 4G, it will have a higher transmission speed, which reaches 30%.

In the same way, 5G will operate at higher frequencies, which will increase transmission speed and reduce delay. In 4G networks, the channel rate is 20 MHz and combined 140 MHz, while 5G channels can have up to 100 MHz in one channel and some operators will be able to transmit signals at 800 MHz – frequencies that were not previously available (Segan, 2020).

Due to the load of 4G low frequencies in networks, radio and television, working at high frequencies will allow for decreased delay and degradation of the signal, increasing its quality. 5G networks need to be more flexible and versatile, as they operate with a much larger number of cells capable of changing size and shape. But even with the use of existing macro cells, a 5G network will be able to increase bandwidth by up to 4 times compared to already existing networks. This is achieved by using a wider bandwidth of advanced antenna technology.

In general, there are three different ways to build a 5G network, depending on the type of asset that the wireless operator has: a low bandwidth network that has a wide coverage area, but only about 20% faster than 4G, a high bandwidth network that has a huge speed, but signals have a poor coverage area due to the complexity of the passage, especially in solid objects and a medium bandwidth network that is balanced in quality and frequency of the signal (Bogs, 2018).

Results. Advanced specialists are confident that the introduction of the new generation of communication networks will allow for a better type of information transfer, while reducing the load on lower frequencies. The new generation of the network will make it possible to start the development and implementation of new technologies in other areas with an ultra-fast and stable type of information transmission.

Conclusion. As a result, users of the new generation network will be able to enjoy faster, better and more stable Internet, with the possibility of choosing the type of network suitable for them, depending on their location and finances.

The world's leading IT companies will have a good foundation in future developments of new technologies, having a 5G network as an excellent method of wireless fast information transfer.

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HANDWRITTEN DIGIT RECOGNITION

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Key words: computer vision, neural networks, image processing

Introduction. Imagine you have a large set of pictures of handwritten digits and you want to make your computer recognize them. Of course, it is an easy task for a human, but a hard nut to crack for the machine. What instruments and technologies can we use? From which point should we start? How can computer simulate the activity of human brain?

Objectives. The main task is to conduct research for ways of getting computer software to recognize handwritten digits.

Methods. Firstly, we have to understand, how human brain learns. If we go deeply into biology, we will learn that our brain consists of a huge amount of small "intelligence units" with lots of connections between them, which are grouped in some specific way. These units are called neurons. Secondly, let's remember how we used to learn digits in childhood. A teacher or parent asked to name some written digits and said the right name if there was a mistake. So, there must be a way to tell computer, if its answer is wrong or correct, so it can learn the names of the given digits. To sum up, there must be some artificial neurons that will be connected to each other and act like real ones, they have to process the given pictures somehow and there also must be a way of telling the computer whether it gives the right answer to a certain picture or not. To simulate a complicated neural network, we should group neurons in layers: each layer is responsible for some step of digit recognition. Also, our network should give 10 numbers as answer – each number shows the probability of certain digit to be on given picture. Each neuron has its own parameters and the task of learning really means finding some values of those parameters for all neurons that will give the smallest possible value of loss function for input data – this function indicates, how accurate are neural networks' answers, and depends on all those parameters called weights. Typical ways of minimizing are some algorithms from multivariable calculus and numerical optimization theory. They all involve complicated computations that nowadays can be done with some specialized programming languages libraries or frameworks. There is also a more advanced way of organizing neural networks – it is called "convolutional neural network". It does not use biological neurons intuition anymore, but has more complicated structure. It uses math operation called convolutions, that means multiplying to matrices in the specific ways, as images can be represented as matrices. This operation somehow extracts edges or another specific features of pictures and is more useful for image processing.

Results. Neural networks for recognizing digits can be written using different programming languages, but the most popular one is Python. There are lots of Python modules, which already have in-built functions for creating the network itself, optimizing loss function and computing network's accuracy. Training time of neural networks depends on used algorithms, amount of input data and hardware facilities of

used PC. Complicated networks should be trained on powerful computers with high-end GPU and huge amount of RAM.

Conclusion. To sum up, creating an artificial neural network that can recognize digits from pictures is quite a hard task that requires knowledge of math, particularly calculus, and programming. Making computer recognizing digits is one of the easiest tasks of field called computer vision, but it this task can be used to understand some basic principles of creating neural networks that will give digital devices ability to see and analyze world around them just like humans do.

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APPLICATION OF ELECTRONIC DOCUMENTATION SYSTEM BASED ON BLOCKCHAIN TECHNOLOGY

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Key words: electronic document management system, blockchain, secure document management, data consistency

Introduction. In connection with the development of the information society and a necessary condition for the transition of the state to automation is the introduction of electronic document management systems, so it is proposed to implement an electronic document management system that implements information protection functions based on blockchain technology.

Objectives. Obtain a secure decentralized repository for storing and transmitting digitally signed electronic documents.

Methods. Given the rapid development of information society technologies and the increase in document management, there is a need to implement an electronic document management system, which should work so that users can access documents in electronic form at any time and be able to verify their authenticity. Such a system in a modern enterprise is an urgent need. With minimal costs for technical equipment and software implementation of the Electronic document management system can significantly improve the quality and productivity of work with a variety of documentation and make information processing more convenient to familiarize.

Electronic document management system will ensure absolute transparency, security and confidentiality, availability and cost-effectiveness, elimination of risks of document loss and unauthorized access to information. The security of the blockchain

system is that the records are stored in encrypted form simultaneously for all participants in the system and are automatically updated with each change.

But there is a problem of software implementation of the algorithm using personal keys of users – this is a technologically difficult task that is quite time-consuming and expensive process and requires considerable funding. Therefore, it is proposed to analyze the possibilities of implementing this system using blockchain technology in the modern Python programming language.

Results. Thanks to the results obtained during the implementation of the electronic document management system, it is possible to formalize the work at the level of functions, processes and data flows, as well as to form and justify the use of software within government agencies.

Conclusion. The obtained estimation helps to determine that the software implementation of this technology is quite possible and can be effectively used in modern society. A high-level specialized Python language was chosen to implement the algorithm.

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SELF-PROPELLED DEVICE WITH ARTIFICIAL INTELLIGENCE

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Key words: self-propelled device, artificial intelligence, computer vision

Introduction. Self-propelled device with artificial intelligence is a complex system that can sensitize the environment and analyse its state for autonomous navigation and guided traffic to its destination in order to perform specific tasks (transportation of loads, study of terrain, and the like). It is justified to use mobile robots and under normal conditions for heavy or prolonged monotonous works, such as in-shop transport in automated warehouses or earthworks.

Objectives. Create self-propelled device, which will perform predetermined actions depending on environmental information, are explored, namely, the actions of the robot will be associated with the presence of distinct features of objects such as their colour, shape, size, orientation, position. The mechanical part should be based on the toy car, which will be controlled by the ATmega8 microcontroller, and the computer (host) will analyse the information received from the webcam installed on car, and then send commands to the microcontroller.

Methods. Self-propelled device is orientated in space and performs pre-programmed actions:

1. Search for artificial labels made up of painted geometric shapes.
2. Search for natural large landmarks in the room (doors, walls, windows).

3. Organization of movement of work in premises on the basis of analysis of landmarks.
4. Analysis of road scenes.
5. Persecution of bodies or objects.

During the development, an external programmer was used to download the firmware to the ATmega8 microcontroller, the program for AVR Burn-O-Mat programmer, the Embarcadero Delphi XE6 programming environment with installed microprocessor libraries (JEDI) and the library for working with the web camera and image processing (OpenCV).

Results. The hardware and software of the manual and automated control of the self-propelled device are developed. We produced a special command module that allows you to transform signals from a computer into an electric current on the microcontroller pins, which is the basis of the command module. Also, a power circuit was developed and manufactured, which serves as an amplifier of the power of electric motors at the expense of an external power supply. We solved five proposed problems of “computer vision”:

1. Search for objects of defined areas of shades of a certain color.
2. Tracking objects specified by the user.
3. Identification of objects in the form.
4. Facial recognition.
5. Determine the size of the objects of the given color.

The finished self-propelled device with five solved tasks of “computer vision” in real conditions was tested. Checked car's ability to perform programmed actions.

Conclusion. Summing up, in this work, computer vision technologies are used for specific tasks of detection and recognition of visual characteristics of objects, namely combining and combining methods of tracking objects (based on algorithms for calculating optical flow), recognizing the shape of regions by the allocated tint, methods of segmentation from the library OpenCV. The software-hardware communication of the analyzed input information with the mechanical part of the self-propelled device is proposed, which allows the device to independently change its position and orient itself in the environment. This work may be of interest to a device that can be used to automate everyday cases, espionage, video surveillance, operations during combat operations.

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FLEXIBLE DISPLAY: THE FUTURE OF SCREENS

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Key words: flexible display, OLED, FAMOLED

Introduction. From the demand for information technology, they, in turn, are developing and improving. Screens are an integral part. Can you imagine having flexible computer screens and mobile phones which change shape to tell you when you have a new message? It sounds like a crazy idea, but in fact it's already been invented! (British Council, 2014).

Objectives. The main task is analyzing the structure, scope of application for flexible display, pros and cons of this technology. This and much more will be described further.

Methods. Flexible displays refer to a type of matrix called FAMOLED, built on the basis of conventional LEDs (organic light-emitting diodes, OLED). It is easy to guess that the main problem in the production of such screens is glass – a heavy, hard and at the same time very fragile material. The solution was to use a protective glass based on a special polyethylene film. Flexible displays can be used as a screen in smartwatches, smartphones, tablets, laptops. Even use on TVs! Such one can be twisted and it will not break! The main pros and cons of these presented in the table 1.

Table 1

pros	cons
Light weight	Low wear resistance, especially with frequent excessive bending
Low thickness (due to the lack of traditional protective glass)	High price
Excellent durability (again due to the lack of breakable glass)	Despite 20 years of research, the technology is still poorly understood
With a sudden power outage, the likelihood of data loss is very small compared to solid state drives.	
Many use cases: in technology, newspapers / magazines, clothing	

Results. Among experts, the opinion that in the future flexible displays will replace hard displays. One of the reasons why this has not happened so far is the high cost of flexible displays, poorly studied production technology. But every year there are new manufacturing technologies that reduce the disadvantages of flexible displays.

Conclusion. Thus, flexible displays are currently a little widespread technology. Despite this, we can say that this technology has great potential. It is very likely that in the near future everyone will have a smart device with a flexible screen that can take any shape.

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FAULT TOLERANCE OF DISTRIBUTED SYSTEMS: THE MAIN APPROACHES

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Key words: fault tolerance, redundancy, hot spare

Introduction. Presently, challenges of fault tolerance are one of the main issues at the high-performance computing. Modern distributed systems, clusters and networks contains a lot of elements, that can fail. As result, every modern high-performant system must be fault tolerant. It makes this issue topical.

Objectives. The objective of this paper is do survey of different approaches of fault tolerance ensuring, compare those and highlight main features, advantages and disadvantages of each.

Methods. There are some approaches to ensure fault tolerance. Redundancy is the simplest of them. The main idea of this approach is to add nodes to the system that have the same function as the existing ones. When there are no faults in the system, they do not perform any task, but as soon as the node "protected" by them fails, they replace it with themselves. One-time redundancy is called duplication. It is the most used variant. But in the important systems, – like control system of a nuclear reactor, – the multi-time redundancy is used.

More advanced approach is hot sparing. This approach differs by the fact, that redundant elements are not idle, but duplicates main node's computations. The results of them may be compared, that eliminates possible computational errors and simplifies fault detection.

There is mixed variant: lightweight spare. This approach sometimes considered as a subspecies of hot spare. The main difference is next. In hot spare redundant nodes performs the same task as the main node, and them load are equal. In lightweight spare only the part of computations is duplicated, and the load of redundant nodes is less than main node's load.

In contrast to redundancy, there is also a non-redundant approach to providing fault tolerance. There are no explicitly redundant nodes in the system, but if any node fails, other nodes can take its role, recovers system virtually. This approach is used on homogeneous systems and in clusters (like Hadoop) and may combine both software and hardware solutions.

Results. The main advantage of simple redundancy (cold spare) relative to other approach is the minimal deterioration of redundant nodes. It allows significantly prolong the system's lifetime. But there are disadvantages. First, turning of redundant nodes and fails' replacing takes a lot of time. Second, all data that the failed node contains, will be lost.

In contrast to this, hot spare allows replace fault at the moment of fail with saving all data. But redundant nodes deteriorate like main node, that improves a probability of them fail. The using of lightweight spare allows to decrease deterioration, but all advantages of hot spare decreases too.

In addition, all of the above methods have a key disadvantage associated with redundancy. Increasing the cost of the system without increasing performance. Redundant elements duplicate computations already in progress, but do not perform other computations.

In contrast, the no-redundancy approach avoids price increases since there is no obvious redundancy. But at the same time, it also has disadvantages. First, the drop in performance during failures. Second, the requirements for hardware, software and tasks that limit the usage of this approach in different areas.

Conclusion. To sum up, every approach has advantages and disadvantages, and can be used in different purposes. For example, in homogeneous systems, clusters and distributed networks, the non-redundant approach is most fruitful. All parts of the system are busy with their tasks, and in case of failure, the task is simply transferred to another node in the system. In contrast, in real-time systems – when controlling nuclear reactors, airplanes, satellites, etc. – a hot spare is needed. Redundant subsystem should be turn into work immediately as soon as the main part fails. In systems where runtime is less critical and where the elements are specialized, such as programmable machines or conveyors, cold or lightweight spare can be used. Also, different methods can be used in the same system. For example, for important and urgent tasks, the hot spare mode is used, and the cold spare or reallocation of tasks may be used for others.

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THE IMPACT OF ROBOTS ON OUR LIVES

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Key words: Robots, Googlebot, Artificial-Intelligence

Introduction. For many years, in science fiction movies and books robots had been something fantastic and had caused in people a sense of the future. Today, however, this “future” has come – robotic integration is also transforming many industries.

Objectives. When we talk about robots, it doesn’t mean only robots that try to imitate people. The meaning of word “robot” in the root has changed in comparison with the previous years. Most of current robots do not have physical body, live in a computer

program and almost all people do not even suspect of their existence. For example, Google invented Googlebot that also called web crawling bot – developers called it a “spider”. Googlebot discovers new and updated pages by processing that is also called Crawling. Google adds them to the Google index, according to the results of this process (Algiryage, Dias, & Jayasena, 2018, p. 1). Each search engine has two or more bots such as Googlebot.

Methods. The common practice of robotics is the invariability of the robot’s shape. All its parts have a fixed structure and are configured to perform certain tasks. Scientists of the Laboratory of Computer Science and Artificial Intelligence MIT (CSAIL) have developed a bot which can be transformed to different shapes (Adam & Rachel, 2017, p. 1). They presented their work in the journal Science Robotics on September 27 in 2017. The robot can be transformed into a “Bot-wheel”, that allow it moves twice as fast as its normal state. “Bot-boat” can swim on the water, carrying loads, twice the weight of the bot. The “Bot-glider” can hover on large distances in compare with size of the bot, using a removable sail. And it is not the end of development! Similar ideas for using of different “suits” for large robots are common, but the creation of such a small structure, capable of transformation, was almost impossible before. According to Eric Diller, a professor at the University of Toronto, the work of MIT scientists demonstrates that their approach successfully copes with creation six different types of transformations in one robot. Previous attempts in majority were limited by only two functions – to take off and put on one exoskeleton.

Results. Today we see the tendency of growth of neural network that opens a new powerful opportunity in constructing different kind of robots with new abilities in predicting. Robot, that working on neural network, is trying to avoid antecedent mistakes, according to the pseudo analyze of previous attempts. As the result, robot becomes smarter in future times. The IFR has upgraded their existing number of industrial robots, which has reached 400000 units in 2018 and has grown 20 percent between 2019 and 2020. This action has incremented the world’s population of industrial robots to more than 4 million in 2020 (Heer, 2018). It means that robotic development of mechanical engineering is growing and growing by each year.

Conclusion. To sum up, we can emphasize, that nowadays people are trying to simplify their lives by many ways, because it gives us an opportunity to give a routine work to robots and spend our time on other, more important things, that today robots can’t do. According to growing statistics of using robots, they are very popular and in great demand of worldwide communities, so we can make prediction, that its popularity will grow more and more year by year.

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BUILDING KUBERNETES-POWERED APPLICATIONS ON CI/CD PIPELINES

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Key words: Kubernetes, containers, continuous integration and continuous deployment

Introduction. Microservice applications are slowly becoming a “golden standard” of modern applications’ architecture. Kubernetes is an open-source container orchestration system (The Kubernetes Authors, n.d.) designed in a way that fits organically into concept of distributed application logic. As the definition of Kubernetes suggests, containers are the base of it – mainly Docker containers with some other potential realizations like containerd, CRI-O etc. Leaving aside the discussion of is it really worth to use Kubernetes in production or even to prefer microservices architecture over monolith, how should continuous integration and continuous deployment (CI/CD) – processes of building new application version and deploying it to desired environment respectively – be handled in such an environment? It is worth mentioning that CI/CD as a concept has already become a significant part of software development process and will persist for a while, thus each new methodology in application building has to be compatible with current meta.

Objectives. The main goal is to identify relevant strategies for building CI/CD processes when using Kubernetes as infrastructure solution.

Methods. Kubernetes may be considered a “software infrastructure” as it provides applications with a unified environment, dealing with hardware in the background – thus it is possible to distinguish 2 different methods for rolling out a new application version. Without going into any details about implementation, general CI/CD process is as follows: CI server builds a new container with updated application code, pushes it to container registry – and next step is where divergence occurs. One approach is to just change container identifier in Kubernetes application configuration (aka manifest), per se pinning everything else as infrastructure, which shouldn’t be changed unless absolutely necessary. This could be done in a (pseudo-)manual manner, using an API exposed by Kubernetes either through a command-line tool, or via sending an http request. Both solutions are error-prone and might leave said application in half-configured way if any connectivity issue occurs, although in general case it still won’t render application failing. The second approach is to generate the whole manifest from the previously applied one, but only with fresh application image identifier, and then apply it – Kubernetes API server performs this swap atomically, so in theory only serious problems might disrupt this process. Later method has a benefit of being more stable, than the first one, although it comes at a price of slightly reduced performance – while

for most projects this won't be a serious issue, bigger ones (and especially those using advanced resources like persistent storage) might start seeing significant delays.

Results. Generating new manifest and applying it over the old one tends to have less issues than dealing with container identifier in stale configuration, so it could be recommended for majority of cases. Although neither of those should be overlooked in specific cases, like cluster with lots of applications or clusters with industrial-grade network connection and advanced safety mechanisms.

Conclusion. In conclusion, there is a number of issues and problems to solve when using Kubernetes, but nonetheless it is a prominent and rather young technology offering multiple approaches in integration with application development process in general. As for tackling CI/CD, different strategies suit the best for specific cases, although the rule of thumb would be slowing down for a greater stability.

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CYGRAPH: GRAPH-BASED ANALYTICS AND VISUALIZATION FOR CYBERSECURITY

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Key words: cybersecurity modeling, graph visualization, situational awareness

Introduction. In the modern world, we have become heavy users of electronics. Even though we have accounts on a vast variety of applications and do not exchange any classified information, we are still pledged about our security on the Net. Yet, we seldom face numerous leaks, unwanted spam, or hidden malicious software. Now, let us think of strategic government facilities for which intrusions would be crucial. We are sure that cyber-attacks and defenses against them should be conducted in complex environments. While attack success and mission impacts depend on numerous factors. Among them, we can mention intrusion into detection systems, firewall settings, vulnerabilities, host configurations, etc. (Noel, 2016, p. 2).

Objectives. The main task of our research is to consider the connection of adversary activities with the network environment. Since organizations should be aware that technology is constantly changing, so intrusion notification and antivirus alerts should be updated respectively. In order to go further than isolated safety assessments, establishments need to merge data into higher-level knowledge of network-wide attack vulnerability and mission readiness against possible cyber-attacks threats and to take decisions (Noel, 2016, p. 3).

Methods. CyGraph combines data from different system's branches into one general multidimensional graph that allows making decisions for critical assets protection much easier. When facing a real ongoing attack, due to CyGraph, possible vulnerable paths for attack dissemination are shown. Because of that, appropriate lines

of action may be chosen, as the graph includes something that may have contributed to the hacking.

Results. The result of fusing data from a great number of information sources is a unified layered diagram-based model. It enables to shorten dramatically the time for analyzing the way cyber threat has come from; therefore, the information about warfare readiness is rapidly made. It also provides the context for correlating intrusion alerts and other kinds of network events, matching them to known vulnerability paths (Noel, 2016, p. 4). In return, it offers the best way to take measures in order to restrict the attack. Moreover, it shows the overarching framework for calculation a wide range of indicators that allow tracking preparedness of security in the future.

Conclusion. To sum up, CyGraph gives access to inclusive query capabilities in its graph base, and through its own query language, it is possible to get the knowledge that is typical to the domain. This grants a range of examination tasks, such as mapping the hacker's possible damage. Besides, CyGraph combines seemingly unconnected alerts and checks whether they make up a coordinate attack. All this gathered information appears on a complex graph.

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MAN-IN-THE-MIDDLE ATTACK

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Key words: information security, cryptography, cyberattack

Introduction. Today, a huge amount of data is transferred from a computer to a computer using a variety of communication protocols. Different information has different importance, which means its security remains an urgent problem. Man-in-the-middle attack (MITM) is one of the most common types of attacks that hackers implement to steal data. Its essence lies in changing the connection between the two sides of communication in such a way they do not realize they are exchanging information with a third side.

Objectives. To define the importance of studying the problem of a man-in-the-middle attack and how to protect your connection from it.

Data protection has always been an important thing, especially in the modern world, where everything depends on information technology.

A man-in-the-middle attack theory and some practical points will help prevent these types of attacks. This will help us understand the risk of such intrusions for our personal lives, since MITM attacks make it possible to invade communications and listen to our conversations.

Methods. A hacker that wants to do a man-in-the-middle attack intercepts all the information transmitted between two sides and can transmit new information. This is very simple, for instance, if you use a Wi-Fi wireless access point. So, hacker has the ability

to easily carry out an attack, for example, by dinting of the spoofing technique. To prevent such attacks, a secure version of the HTTP protocol has been created. The new secure protocol is called HTTPS. Using a browser, you can check the address bar to find out if this protocol is used.

In general, it can be assumed that a delay test can sometimes be very useful. For instance, if you deal with a long calculation of hash functions, it takes about 10-15 seconds. To identify possible attacks, the parties check the discrepancy in response time. If two parties know how much time they usually spend sending a certain response, then if one transaction takes too long to reach the other side, this may indicate the intervention of another party, this will entail an additional delay in the operation.

To detect a person-mid-attack, it is also very important to study the parameters of network traffic. For example, to detect an SSL attack, you need to pay attention to the following parameters: DNS server, a certificate is signed by a certification authority or signed independently, the server IP address, X.509 server certificate, as well as other certificate parameters.

Results. Thus, the man-in-the-middle attack seeks bypass reciprocal authentication. If you want to prevent MITM attacks you should give preference to many protocols, that include any ways of authentication.

The user's task is to protect his browser and computer to prevent the insertion of a fake certificate. You need to pay attention to the list of trusted certificates and remove those that you do not trust. And of course, caution is essential when you connect to free or insecure WiFi networks.

Conclusion. The importance of the ability to protect your data in the information space does not need to be proved to anyone in the modern world. A data leak of one person is a very unpleasant event, and a data leak of a large enterprise can cost a lot of money, which attackers want to take advantage of. They improve their attacks faster than security experts learn to prevent them. Thus, the problem of attacks in cryptography remains relevant and unresolved.

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CREATING INTERACTIVE VISUALIZATIONS DATA SCIENCE PROJECT

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Key words: data science, data visualization, framework, web application, Python

Introduction. A machine learning project will never truly be completed until we can demonstrate the results. In the past, a well-done visualization or a small PowerPoint

presentation was enough to showcase a project, but now a good data scientist should have some understanding of web visualizations. But the problem is that web frameworks are quite difficult to learn. HTML, CSS, and Javascript look complex enough, and even something that looks simple to execute only starts working after a lot of trial and error. But now many frameworks make the task of data visualization as Ippolito stated (2019).

Objectives. The research aims to investigate the application of Python's Dash framework is investigated to create web applications that can display all the necessary data scientist's information.

Methods. To gain a better understanding of the problem, the literature on the selected topic was analyzed. One of the frameworks for quickly and easily creating web applications is Dash. It is a user interface library for creating analytical web applications ("Dash Overview", 2020). Those who use Python for data analysis, data mining, visualization, modeling, instrument control, and reporting will find a use for Dash immediately (Leong, 2020). To conclude the popularity of this framework, it was decided to create a comparison table. Dash has been compared against frameworks like Django and CherryPy on the following criteria: a group of frameworks; Github stars; Github releases; the number of copies of each project made, which shows the popularity of using the project in your work; the number of questions asked about a specific topic; a number of vacancies related to technology or IT competencies.

Results. The analysis of the frameworks showed that although dash is inferior to Django, it has better results than CherryPy. The results can be seen in the table 1.

Table 1

Frameworks comparison

Framework Name	Framework Group	Github Stars	Github Releases	Github Forks	Questions on stackoverflow	Jobs
Dash	Micro	1 247	216	25 400	158	47
Django	Full	46 528	275	20 400	217 300	679
CherryPy	Micro	1 130	127	279	1 300	3

The reason for such results may be that dash is a completely new frame and is only gaining popularity. With its many visualization features, Dash makes it much easier to create GUIs (Graphical User Interfaces) for data analysis.

Conclusion. Dash is an open-source Python library for building reactive web applications. It will be useful to anyone who uses Python in data analysis and exploration, visualization, modeling, and reporting.

Dash is licensed under the MIT license. You can find the library manual on the official website, and the source code on GitHub. Dash itself is declarative and reactive, making it easier to build complex applications that include many interactive elements.

To summarize, the Dash library delimits all the protocols and technologies needed to create an interactive web application because of the separations between Python components and reactive functional decorators. Dash is pretty simple to bind your user interface to Python code in just one evening, which is certainly good news.

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ALGORITHMS FOR NONLINEAR TASKS CLASSIFICATION

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Key words: data science, data analytics, machine learning

Introduction. Classification tasks have a wide range of algorithms, based on different approaches to dealing with data. Usage of basic algorithms for classification (KNN, SVM with linear kernel, logistic regression) can provide several benefits. First of all, they are easy to understand so the researcher can easily boost parameters for his needs. Besides, the models, based on these algorithms, have high accuracy. However, these methods have the limitation: they have a poor performance on nonlinear data that cannot be divided into different classes by a straight line. Lately, algorithms for nonlinear classification tasks are becoming more and more widely used as a wider range of tasks could be solved efficiently.

Objectives. The main task is to conduct the research regarding methods for nonlinear classification, explore their advantages and disadvantages as well as find their limitation of usage.

Methods. First of all, we have to process different researches of statisticians and data scientists to select the most suitable methods for nonlinear classification. According to different works, the best algorithms suitable for this task are the SVM (Support Vector Machines) with the RBF (Radial Basis Function) kernel; Neural Networks; the Random Forest (Gradient Boosting and Kernel Random Forest). After methods being selected, we should build models and compare their productivity (accuracy, precision, ROC-AUC score, memory and time usage etc.) To achieve a high level of reliability of results, we have to conduct multiple experiments using different datasets taking into consideration a number of observations, type of features (categorical or numerical), different statistical properties of data (e.g. high covariation).

Results. The highest accuracy compared to other algorithms was achieved using the SVM with the RBF kernel. Besides, the overfitting problem, which is a situation when high accuracy on training data and low accuracy on testing data is achieved, is not observed as often as with the usage of other methods. However, this method has some

crucial drawbacks for some developers like computational expenses, a long process of selection of the right kernel, especially regulatory. This technique is also not efficient for solving the problem of multiclass classification.

On the other hand, the neural networks can easily identify different types of relations between variables, but not explain them. Also, this procedure is a good choice for a dataset with plenty of noisy data. However, the usage of the algorithm does not often provide the most efficient solution as it can be stuck in local minimum of minimization problem of LSE (least square error) function. Overfitting is also a problem while using this method.

Finally, the random forest algorithm provides a possibility to handle both numerical and categorical data. This technique gives an opportunity for a researcher to build a model with high-dimensional data as input and easily interpreted results as output. The main disadvantages of the method are the instability of classifier (the performance of the model highly depends on the quality of initial data), the overfitting problem and the generation of categorical but not numerical output.

Conclusion. To sum up, nowadays more and more researchers are using new approaches for solving the classification problem. Among them, the algorithms that are gaining popularity are neural networks (or deep learning), SVM and random forests. However, all the methods have its drawbacks and limitations, so the researcher should conduct several experiments to decide the best technique for classification.

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SPEECH RECOGNITION USING HIDDEN MARKOV MODELS

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Key words: Hidden Markov Models, speech recognition, phonetic models, computer learning

Introduction. For almost 70 years, mankind has been setting itself the task of speech recognition in order to remove an intermediary in human-computer communication. Controlling a machine with a voice in real time, as well as entering information through human speech, will greatly simplify the life of a modern person. To

teach a machine to understand, without an intermediary, the language spoken by people are speech recognition tasks.

Currently, almost all automatic speech recognition systems are built on the basis of several basic approaches: hidden Markov models, artificial neural networks, dynamic programming. Latent Markov models have recently become central to automatic speech recognition processes. They have low hardware costs and high performance, which does not depend on the length of the observed sequence and the number of states of hidden Markov models, due to massive parallelism and pipeline nature of calculations. Hidden Markov models not only allow solving speech recognition problems, but also improve the quality of a signal contaminated with noise and distortion, help to model the source of a speech signal, optimize the structure of a dialogue, and much more.

Objective. Automatic speech recognition in real time.

Methods. Using hidden Markov models (HMM), statistical models of phonemes, words, and whole phrases are constructed. Today, the following approaches can be distinguished:

1. Models of phonemes – sound letters of the language that can be combined into words – are made on SMM.
2. Phonemes are modeled using three states – initial, middle and final.
3. Phonemes sound differently when they are surrounded by different phonemes. It is a coarticulation effect. Depending on whether this phenomenon will be taken into account or not, they distinguish: monophones (coarticulation is ignored) and triphones (coarticulation is taken into account by compiling separate models for phonemes surrounded by other phonemes).
4. They compose separate HMMs for each word from the dictionary and, when recognizing, choose the one that is most suitable.
5. HMM is composed by gluing HMM for words through intermediate states (for example, silence), according to the grammar of the language.

Such phonetic models are built automatically at the stage of training the recognition system. For this, acoustic-phonetic databases are used, which are large arrays of sounding speech, recorded from many speakers, phonetically marked and provided with transcription.

Before training, the training acoustic material is subjected to digital spectral analysis. As a result of spectral analysis, the training acoustic signal is converted into a sequence of time slices, each of which contains information about the spectral envelope of the signal over a small time interval.

After training, the system can work as a speech recognizer. Recognition of a spoken sentence begins with its spectral analysis. The resulting sequence of spectral vectors is compared with theoretically possible (phonetic models) sequences of vectors. Special search procedures allow you to select the sequence of words that is most likely in terms of the acoustic picture.

Results. The system works on the principle of “analysis by synthesis”. Unfortunately, such a system does not provide reliability in the recognition of continuous speech even in dictation mode, which, for example, the recognition systems

for a small set of words and phrases have.

Conclusion. Regardless of what has already been achieved, there is still a lot of work to be done by researchers developing human speech recognition systems. In the near future, the tasks of recognizing and understanding human speech will occupy a central place in speech technologies.

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ARTIFICIAL INTELLIGENCE IN SOCIAL LIFE

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Key words: artificial intelligence, computer science, developing, chat bots

Introduction. We live in the world where technology plays an important role of our life. Every day people make discoveries in the world of technologies in order to make our life easier. Now most companies are trying to develop the sphere of artificial Intelligence – AI. AI is used in a big number of devices from smartphones and TVs to robots and cars. Also, artificial intelligence is used in many programs as chat bots. Thanks to them, people do not feel lonely and can communicate with them like real people.

Objectives. The main task is to use artificial intelligence to help people who feel lonely and lack communication. It will help people not to get depressed and inclined to suicide.

Methods. Artificial Intelligence is an area of computer science that allows computer or any other smart device to behave like a human. People use it for speech recognition, learning, planning and problem solving. Special bots and apps with Artificial Intelligence are being created in order to gather information from messages written by people who gives them an ability to generate other messages on the bases of what they have learned. Unfortunately, there are also unsuccessful projects in this sphere. For example, chat bot Zo from Microsoft. After it was launched on Twitter, it started talking about prohibited topics and was soon deleted. And it learned all this from people.

Results. Artificial Intelligence in Ukraine is developing very fast. Ukraine is among top three countries with the number of companies in the sphere of AI in the Eastern Europe. According to the AIN's statistics, in Ukraine there are 57 companies that operate in the field of AI. Only Poland has more companies (110) in the region. (AIN, 2019, para. 2) Our country also has special platform where everyone can find all information about Artificial Intelligence. It helps ordinary people to keep abreast of the latest news in this area. There is a lot of companies which create special chat bots and develop artificial intelligence in general.

Conclusion. In the near future we will be able to communicate with the chat bot as with a real person. Also with AI, we can study those places in our world that a person cannot get into. For example, in astronautics and in the exploration of ocean depths. In the future, the number of areas where AI is applied will only grow. Because AI is really important sphere of computer science and it will help us in our life a lot of time.

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INTRODUCTION TO RECOMMENDATION SYSTEMS

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Key words: machine learning, recommendation system, collaborative filtering, content-based recommendation system

Introduction. Machine learning, as a main part of artificial intelligence, is the technology that helps us to analyze huge amounts of information in order to find some patterns and gain a crucial information about our business. This knowledge can be very useful and have a huge impact on our everyday life. This discipline has lots of

algorithms, methods and different approaches, that work differently and can be divided into supervised and unsupervised learning. Nowadays, actually, all of them are used to automate and improve various decision-making processes in different ways. One of the most crucial examples of such processes is making recommendations for items and products for customers, such as books to read, clothes to buy, music to listen, etc. There a group of algorithms, called recommendation systems, that can be used to solve such practical problems.

Objectives. The main goal is to give a brief overview of basic recommendation systems concepts, ideas and algorithms that can be implemented and integrated into existing products to help users discover items they may like, predict their interests and, therefore, recommend the most interesting and suitable items for them.

Methods. During this work, we will consider the main methods, techniques and types of recommendation systems, such as collaborative filtering, content-based recommendation systems, define their advantages and disadvantages and give some example of usage in real-life applications.

Results. Recommendation system is a family of algorithms that can be attributed to unsupervised machine learning algorithms. This group of methods uses specific approaches to predict whether a particular user would give any preference to an item. The main purpose of such research is to find out whether we need to recommend this item to a particular user in order to increase our business metrics. Actually, working with recommendation systems, we can use a specific information about users and items, called characteristic information. Furthermore, we can collect some information about previous preferences for a given user so that we can analyze its behavior and use it to make further recommendations more accurately. So, we can pick out three main groups of algorithms which use different types of information to get recommendations: content-based systems, collaborative filtering and hybrid systems.

Collaborative filtering evaluates similarity among different customers using past interactions for users and items that we have to recommend. The main idea is that prediction will use all the information gained from historical preferences for given customer. So, before generating a recommendation, this algorithm looks for similar users to a given user, finds patterns in their behavior and finally recommend some items that similar users prefer in the past. Speaking about the similarity metrics between two users, we should mention cosine similarity and correlation coefficient as basic approaches.

Algorithm that is described above, despite its simplicity, is one of the most popular recommendation systems algorithms, but it has some crucial drawbacks, especially when we want to use this algorithm for newly created users or products.

Another algorithm that is proposed to overcome all drawbacks described above is content-based recommendation system. This method is more complicated and uses some additional information about customers and products to get more accurate predictions. Actually, this method finds the most related items for those, that user preferred in the past using additional features. Because of this improvement, method works really well when we don't have so much information about given user and therefore our recommendations can be more accurate and powerful.

Conclusion. To sum up, recommendation systems can have a crucial effect on any decision-making processes in almost all companies. To integrate it means to use all benefits from data collecting and processing that you can bring to your business. As an examples of using such services, we can highlight YouTube, Spotify, Amazon and Netflix. These companies have increased their sales only because of the fact that they have very closed and personalized offers for their customers.

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HOW NEURAL NETWORKS WORK

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Key words: Neural network, deep learning, neuron, optimization, algorithm

Introduction. Over the past decade, computers have noticeably improved their ability to understand the world around them. Photographic software automatically recognizes people's faces. Smartphones convert speech to text. Robocars recognize objects on the road and avoid collisions with them. At the heart of all these breakthroughs is an artificial intelligence technology called deep learning. Deep learning, in turn, relies on neural networks – data structures inspired by networks made up of biological neurons.

Objectives. It seems to us that neural networks are a new field. In fact, they are quite old. The first studies of neural networks date back to the end of the 19th century. All tasks that neural networks can solve are somehow related to learning. Among the main areas of application of neural networks are forecasting, decision making, pattern recognition, optimization, data analysis, control.

Methods. Neural networks have two phases: the training phase and the use phase. The learning phase is: you take data and change the parameters of the path or the mathematical algorithm that the path represents. You change the parameters to match

the data as closely as possible. When you use a network, you do it differently: you have a trained network, and you enter data into it, and it gives you an answer very similar to what it learned.

Results. This is how neural networks work. Recently, the so-called deep learning has appeared. Previously, the gradient descent method was used (Kelley, 2018, p.17), based on the search for efficient algorithms to determine the local minima of the error function between the input information and the required result. Recently, it has been supplanted by deep learning, where you use many levels of nonlinear optimization so that you tune the path parameters to the data as closely as possible. Deep learning, on the one hand, is very new compared to previous backpropagation training (Schmidhuber, 2015, p.85–117). On the other hand, it is possible due to the greater speed and power of modern computing devices, so that we can carry out many optimizations in a short time. Another important form of learning is reinforcement learning. Many of the breakthrough results of neural networks in games are based on a rather old technique that dates back to the work of psychologists – reinforcement learning (Hoskins, 2017, p.91). Reinforcement learning is that you perform an action, and then, depending on the result, change the parameters, the way of performing the action so that next time you will be more successful. Then you repeat this process. You always reinforce choices that increase your chances of success, and weaken choices that decrease your success in a task or activity, such as tracking objects flying across the sky. You can use Reinforcement Learning to make the tracking better and better, adapt your actions to track the object more accurately.

Conclusion. To sum up, I would like to say: on the one hand, we are dealing with a very old field – established, with connections with neurophysiology and brain research. On the other hand, we use technologies that have become possible due to the explosive growth of computer power. We know that neural networks are good at approximating continuous and bounded functions, and that's why we use them. On the other hand, many of the tasks that we set before them are insoluble, that is, even the most powerful computer in the world will not be able to answer such questions. However, we use these devices in some heuristic manner.

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READING INFORMATION THROUGH VIBRATION OF MATERIALS

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Keywords: vibration sensor, vibration, signal, decoders

Introduction. The field of information security in today's world is becoming increasingly important when digitization conquers all areas of human existence. Since there is information, it is possible and its leakage (theft). In particular, leakage occurs through acoustic channels and vibration.

Objectives. The main task is to conduct research on methods of receiving leaked information. The most important thing is to find out how vibration is perceived and its propagation channels.

Methods. When perceiving vibroacoustic channels, such parameters as vibration displacement, vibration velocity, vibration acceleration, as well as the phases and frequencies of harmonics should be taken into account. The reception of vibroacoustic information is usually received by a vibration sensor, which consists of a vibration transducer, a frequency filter, a signal amplifier and an amplitude meter, which allows converting the vibration signal into a digital data stream. There are different configurations of vibration sensors and their modified designs, for example, the connection in one housing of the vibrating receiver and the signal amplifier will give greater sensitivity and protection against interference. Also, information can be received using microphones, only if there is an acoustic signal. To do this, a system is included, which includes a receiving membrane, a signal amplifier, a frequency filter and a converter into a digital signal.

Results. With the help of these devices, experts can receive information at a very weak level and convert this signal into digital data. Which allows you to find such leaks in the future and avoid them in different ways, for example by increasing noise isolation, or using certain interferences in reading as different types of noise, including white noise, which equates to audience noise and significantly reduces the ability to recognize the sound and other «color» noises that differ in frequency and cover the entire frequency range.

Conclusion. Summing up the study of methods of reading information through vibroacoustic leakage channels, we see that there are devices that can read vibrations and convert them into a stream of digital data; and there are devices that provide greater security of information, creating different origins of acoustic and vibrating noise.

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DOCKER AND CONTAINERIZATION IN SOFTWARE RUNNING AND DELIVERING CONTEXT

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Key words: containerization, typical clients' problems, software reusing, delivering of the product

Introduction. During the process of delivering the software product to a client, developers face a bunch of problems. They spend a lot of time to prepare different files, scripts, and installation instructions. Then typical clients' problems appear, like: "Nothing of your software works for me", "Your installation script crashed during the execution - what should I do now?". Everything becomes worse when your company has hundreds or even thousands of customers. It is also getting harder to remember how to install new versions of product.

That's where the concept of containerization comes in handy - it helps to control your environment.

Objectives. Create a software where:

- we can control environment, like in virtual machines;
- we have effective control of server resources usage
- get rid of nasty vendor lock-in, so we can run our software anywhere we want.

Methods. Earlier those problems were partially solved by creating certain scripts. Other companies used cloud services, but today their performance is worse than dedicated servers. Somebody could also use virtual machines, but they were also not perfect – their size is huge and they are hard to customize for resource usage optimization.

To avoid all these weaknesses and bottlenecks, Docker was invented. It uses containerization approach. Like a virtual machine, Docker runs processes in previously configured operating system. But at the same time, all Docker run the physical host server, sharing all processors and available memory with all other processes running on the host machine. Docker's approach is halfway between running everything on a physical server and the full virtualization offered by virtual machines. This is what called containerization (Merkel, 2014).

Let's have a closer look at Docker workflow.

To start, Docker creates an image with the help of script called Dockerfile that you should prepare. Those images can be inherited and upgraded as developer needs grow. Most often the image is based on a certain Linux-driven system, such as Ubuntu, Alpine and others (McKendrick, Gallagher, 2017, p. 29).

Then we as developers can create a container from the image. Container is already a machine itself, which can be run and stopped. The very important thing about containers is that they are customizable – we can set a huge amount of parameters, from environment variables to web server domain name. We can check containers' statuses, automatically restart them in case they crash and do many interesting kinds of things.

Results. Taking all of the Docker advantages, we can efficiently solve frequent problems, such as:

- comfortable transfer of the server project to the client;
- ensuring replicability of servers;
- reusing previously created server configurations.

Conclusion. On the whole, containerization is the part of the installation automation process which helps developers and development teams to build and ship their applications. This approach is a huge step for generalization of programs running and it makes hard developers' work a little bit easier and more comfortable.

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CREATIVITY OF MACHINES OR HOW ADVERSARIAL NETWORKS GENERATE NEW ART OF THE 21ST CENTURY

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Key words: deep generative model, contemporary art content, neural network

Introduction. Our society is in the age of machine evolution where virtual assistants, gadgets of Extended and Augmented Reality or 3D objects are no longer just buzzwords and visions of the future. Artificial Intelligence has changed our life in all aspects. Nowadays, almost every sphere of human activity is closely interconnected with the process of continuous analysis, optimization and forecasting which is created and controlled by machine learning algorithms or neural networks. Who would have thought that music can be created without musicians, videos and photographs can be taken without photographers or paintings can be painted without artists? We are witnesses of the fact that currently machines are developing the capacity to create absolutely new things, not just learn.

Objectives. The main task of this paper is to investigate the impact of deep neural networks, in particular Generative Adversarial Networks, on the creation of contemporary art content. Apart from that, an additional objective is to explore trends in the creation of applications that generate art without involving a human.

Methods. Tasks defined above will be solved using the following methods. First of all, we will use formalization in order to provide an outline of this research in exact terms and avoid ambiguity in understanding. The second one will be a system method by which we can present the results in the form of a holistic system of relationships of two seemingly incompatible areas – Artificial Intelligence and art. At the final step we will conduct a comparative analysis of such Adversarial Networks as Deep Convolutional GANs (DCGANs) and Creative Adversarial Networks (CANs).

Results. Nowadays Generative Adversarial Networks is one of the most popular designs in neural network technology that offers great potential in the world of Artificial Intelligence and has been widely used in numerous research projects since its inception in 2014. Its architecture can be represented as a min-max game between two players. One of them is a generator – the neural network which maps latent variables from a vector onto the desired result space. In other words, it generates a random picture that is very similar to the picture from a training set but is not really from there and sends it to another sub network – a discriminator. The main aim of this “player” is to expose a generator and reveal an obvious fake. The next step of this research is to dive into GANs through the prism of its modifications. The first example of implementation of modified GANs is Deep Convolutional Generative Adversarial Networks, or DCGANs for short. These Adversarial Networks, in contrast to GANs, have an extended architecture by usage of convolutional layers which can improve the quality of the generator and the discriminator for image generation tasks. The improvement in results is due to the fact that neurons in convolutional layer are placed in three-dimensional structures, where they are connected only with few others from previous layer. Thereby we can get better image processing and at the same time lower learning costs. Nothing surprise that DCGANs is considered like one of the powerful tools to create new arts at present. It’s worth to say about a GANgogh project which was created by Kenny Jones and Derrick Bonafilia. Their pictures were generated by DCGANs but most of the people have recognized them fascinating with pleasing color mixtures and high artistic content. One another example of modification an existing GAN architecture is Creative Adversarial Networks, popularly known as CANs. This type of deep neural networks mostly modifies a discriminator component of GAN objective function. Actually, modified configuration of the discriminator consists of two parts. The first one, like in GAN models, tries to predict whether the input picture that is created by the generator is real or fake optimizing so-called real-fake loss. The second one, firstly proposed in CAN architecture, tries to approximate a probability of getting a particular style of input image. This component optimizes style classification loss and style ambiguity loss in order to get more accurate and robust predictions. This combination of loss functions in the discriminator gives us an opportunity to create realistic pictures exploring a huge area of provided art space. Therefore, deep learning models, followed by CAN configuration usually works well with art generation problems. One of the most impressive examples of implementation of Creative Adversarial Networks is AICAN developed by Ahmed Elgamma. It is mainly introduced as an Artificial Intelligence artist.

Conclusion. To sum up, Generative Adversarial Networks, in particular Deep Convolutional GANs and Creative Adversarial Networks, have been rapidly capturing the world of art at present. In modern life art connoisseurs can visit at virtual exhibitions, admire pictures created from lines of different texts or buy fascinating paintings that are the masterpieces of artificial intelligence.

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MODERN INFORMATION TECHNOLOGIES

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Key words: Internet, Information technology, Instagram

Introduction. Informational technology – a set of methods, production, software and technological tools integrated into the technological chain, which provides collection, storage, processing, output and dissemination of information. Information technologies are created to reduce the complexity of using information resources (APEPS department of Igor Sikorsky KPI, n.d.).

Objectives. To explain the idea of the importance of modern information technologies for the society.

Methods. Nowadays, in the time of high technology, people are more and more turning to the Internet with various issues. For example, if a person wants to order something for himself / herself – most likely she / he will do it with the Internet, it's more convenient and faster than going to the store. Some people even order food through the Internet: not only something already cooked (pizza or sushi), but also ordinary food such as bread or milk. Such an opportunity is needed for people who do not have time to go to a supermarket or people with health problems who are not able to buy products on their own. Sellers come to the internet.

So they can show off their range of products to sell to people who don't want to visit their stores. You can also use publications with a range of products as advertising. The Internet is everywhere and, because of this, each of us can be a journalist. Thanks to Instagram, many people are now interested in photography. Instagram, a social sharing network based on photo sharing, allows users to take photos, apply filters to them, and distribute them through their service and a number of other social networks

(Semantic, n.d.). Thanks to Instagram, anyone can find like-minded people by typing or liking a particular topic. Personally, I like to take pictures, and since school I have tried not to miss a single frame. If I do not have a camera with me, I'll take a picture on the phone. Thanks to modern technologies, you can even take a good shot on the phone. This is to some extent even more convenient than the camera, so you can immediately correct the photo. For example, with Snapseed or PixArt.

Results. Due to the fact that Instagram is gaining popularity, everyone can see what is happening in the world. There are even special websites devoted to a certain topic. For example, a black and white photo of certain countries or cities. As an example, I can make an Instagram account dedicated to Kyiv – kievgram.

Conclusion. Thanks to the development of high technology, people have access to the internet anywhere. There are special programs through which, through the Internet, people can develop and learn something new.

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DATA SCIENCE: THE FUTURE AND NEW TECHNOLOGY

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Keywords: Data Science, internet of things, machine learning

Introduction. Overtaking the corporate world is the idea of the digital transformation, which essentially means upgrading all processes, systems and solutions for the modern age. Thanks to mobile, online or cloud computing, and service-based solutions, nearly everything and anything requires robust streams of data to operate.

Today, data science is a revolutionary technology. Data science is the collection, storage, organization and analysis of large amounts of data. It studies technologies and tools to interact with them. Artificial intelligence, machine learning and robust analytics allow to process and understand large data warehouses at high speed. The field of data science is huge, but it has both advantages and disadvantages.

Objectives. The main task is to determine the field of study of data science, advantages and disadvantages, to identify new technologies.

Methods. For many industries, data is their fuel. Scientists help companies make important decisions. Nevertheless, there is a problem of customer privacy. Modern scientists can help identify trends for more informed decisions. There are many new technologies for data transmission. This increases the need for data processing and analysis.

Results. Data science has many advantages but to understand the big picture we need to know the disadvantages as well.

Advantages of Data Science:

1. Great demand
2. Wide range of positions
3. High salary
4. Versatility
5. Improvement of large data samples
6. Prestige
7. Challenge
8. Lives saving

Disadvantages of Data Science:

1. Blurred terms
2. Impossible complex study
3. Unexpected results
4. Problem of privacy

Conclusion. About 95% of businesses have some need or requirement to manage their unstructured data, made more applicable through big data analytics and related analytics tools. Furthermore, 53% of the world's biggest companies already have or plan to adopt big data analytics solutions.

Data science is evolving very fast. Modern technologies allow understanding that this area will be available for different level businesses. The number of channels and sources of information is constantly increasing. Data science allows you to automate business processes. The future of the data processing industry will become more expansive. Many organizations consider it necessary to apply data science.

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HYBRID DRONE CONTROL SYSTEM WITH SECURE EMERGENCY MESSAGING CHANNEL

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Key words: aerial vehicle, secure communication, IoT, multicopter

Introduction. Currently, most unmanned aerial vehicles are controlled using an unprotected radio channel. The most popular frequencies are 2.4 GHz (Wi-Fi) and 5.8 GHz, so almost all transmitting-receiving devices for connected drones and consoles operate on the same channel of the allocated frequency. In addition to the problem of intercepting and stealing control over the multicopter, there is another problem of protecting the transmission channel of the collected information. This is a relevant task

for military reconnaissance drones, the transmission of encrypted messages and emergency commands. Additionally, due to the strong noise level of almost all allowed communication ranges in the city, a necessary condition for improving the communication channel – the ability to send a signal below the noise level.

Objectives. To define suitable transmission protocols for controlling and sending different types of messages as well as configuring the operation of hybrid communication with a multicopter.

Methods. In order to create a closed ecosystem of information exchange, which will be easily scalable and manageable, we need to use modern technologies for information transfer. According to experience of our European colleagues, the NB-IoT (Narrow Band Internet of Things) standard is very popular in cities, which is a good solution for machine-to-machine interaction provided by cellular operators (Mekki, Bajic, Chaxel, Meyer, 2019). NB-IoT allows establishing communication at a sufficient speed (60-200 kb/s) for transferring photo/video sequences and controlling commands in the real time. The well-known NB-IoT cellular operators are: Vodafone, True Move, Bell, etc. In fact, the equipment for NB-IoT already exists on cell towers in every city and it only requires a software update for each gateway. Nevertheless, the limitations of NB-IoT include work in a licensed frequency spectrum. Thus, it is necessary to use the cellular operators' services, buying out a part of the radio spectrum. At the same time, the allocated range requires constant synchronization of devices after exiting hibernation mode, which consumes more battery power than LoRa-based protocols.

In order to work in the rural areas and compensate for NB-IoT main time exploitation deficiencies, the given study proposes the LoRaWAN protocol. The advantages of LoRaWAN solution (e.g., noise immunity, reliable crypto-protection with AES-128b CMAC standard, operation below the noise level and low battery consumption) can be used to transmit emergency commands and secret messages (Kopaniev, Progonov, 2019). First, the alleged attacker does not expect the device to operate simultaneously in the Gigahertz and license-free 868 MHz bands. Secondly, the command transmission mode through LoRa can potentially solve the problem of returning the device to the base or finding it after the main battery capacity is discharged. As a solution, we propose a software implementation that allows the data transmission system to be aimed at the LoRa channel transport mode after reaching a low battery charge. Consequently, due to the lowest possible power consumption, the device will be able to “hover” in anticipation of commands, return to the base upon request, repeat crash location data to a secure channel, and transmit encrypted cryptograms up to 256 bits per message.

Results. Thanks to the use of 3D-printing technology, a digital model of the drone body was developed and a real prototype was built. Special mounts for the camera, battery placement, microcontroller placement, and motor control boards were created. We also chose ATmega-328P as the control processor (due to the open source code, suitable libraries and the availability of the necessary outputs to work with sensors).

Switching to LoRa data transport mode occurs when the battery reaches 10%. Since the technology is asynchronous, the “trigger” sends information about reaching the specified charge level to the nearest gateway, after which the device switches to C

mode – continuous connection. Until this moment, the copter hovers in the air, waiting for a connection and responding only to emergency commands. The camcorder turns off due to the inability to fit the amount of transmitted data into one message. With the transition to the LoRaWan mode, the communication range increases 10-20 times (up to 15 km) in rural areas. The tests of the operation of the transmission modules were carried out, showing the successful transportation rate of 97% of packets without errors, which is an acceptable result for the study.

Conclusion. After analyzing different communication models and systems, we suggest using hybrid structure with utilizing NB-IoT and LoRaWAN technologies for multicopter maintenance. Experimentally obtained 97% rate of the received correct messages proves the high reliability of the developed solution. The next step of the research could be the creation of multifunctional module-based drone that is able to respond to different emergency situations (e.g., searching for lost people or watering forest fires).

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APPLICATION OF GENETIC ALGORITHM TO SOLVE CRYPTOANALYSIS PROBLEMS

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Keywords: encryption, cryptanalysis, genetic algorithm

Introduction. Information security is provided by cryptographic methods of protection. Accordingly, cryptanalysis methods are being developed. One of the modern directions is the application of evolutionary computation schemes, which include genetic algorithms (GA).

Objectives. GA arose on the basis of observation of natural processes of evolution and selection of populations of living beings – individuals of a certain species. When describing GA we usually use terms borrowed from genetics (population, chromosome, gene, genotype, phenotype, allele, locus) (Panchenko, 2007).

Methods. A genetic algorithm is an evolutionary search algorithm used to solve optimization, modeling, or decision support problems by sequentially selecting, combining, and varying the parameters sought using mechanisms that resemble biological evolution. The function of adaptability (utility, suitability) expresses the degree of adaptability of individuals in a population. This function allows you to assess the degree of adaptation of specific individuals in the population and select the most

suitable according to the evolutionary principle of survival of the fittest (Urbanovich, 2014, Kazharov, 2004).

Results. In optimization problems, the fitness function is usually formed on the basis of the objective function and is optimized. The main operations of GA are crossing, mutation, selection.

Conclusion. The application of GA to solve theoretical and numerical problems of asymmetric cryptography – problems of factorization and finding a simple divisor of a number that belongs to the class of computationally complex. The advantages and disadvantages of using GA in solving these problems are analyzed.

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AI CAPABILITIES AND PROSPECTS

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Keywords: integration, development, AI configuration, automation

Introduction. AI is a powerful driver of progress, which is determined by the constant development of integration into society. This system has not left anyone indifferent so people tried to discover its full functioning by all means. Is it possible to attract evolution to differential technical systems and automation of the environment?

Objectives. The emergence of artificial intelligence is associated with the advent of Pascal computers. 17th century was a period when many scientists were imbued with the system-software idea. Creation of permanent methods in such systems led to the emergence of specialized algorithms. Alan Turing experimentally determined the possibility of the machine to be similar to humans. So it is not surprising that the modern implementation of the representative of AI as ASIMO – a robot that thanks to certain algorithms include the ability to avoid obstacles and move up the stairs. Such Kismet is a robot, which is determined by social nature, namely human skills.

Methods. Later complex tasks, later switched to automation in, when people did not need to work in such an environment, because they had a decent replacement, in some cases, in terms of technicality and uniformity of the machine with AI, perform such work flawlessly, unmanned control devices, thanks to sensors and reception of stimulus signals, the system responds instantly. After all, artificial intelligence is an image of the human mind, which is close to the neural system; the answer is not primitive in the execution of algorithms, but their new generation, the variability of certain actions according to system complexity. The possible expansion of artificial intelligence gave rise to the creation of the system of the Smart House and similar will

accept our requests and immediately use within the device, the level of communication with man is colossal. AI even surpassed man in some cases and returning to the stereotypical vision of the image of AI in robotics. Creating bots that deal with the independent operation of social networks, although sometimes fail in a negative direction, the situation that happened to Facebook in 2017. Adding more to robots, they are a more cumbersome embodiment of AI, because they have a physical resemblance to humans, which is confirmed by scientists, believing that with the full transition to functioning robots not as a technology but as a computer being, they will be able to live similarly human life.

Results. After conducting a general analysis of AI, you can outline the following list of prospects: full automation of the environment, physical and technical control, globalization of computerization, upgrades in the areas of work, increasing the quality of the business industry, the introduction and improvement of the medical industry.

Conclusion. In summary, Artificial Intelligence is an ideal factor for maintaining the development of society. And its prospects and achievements are endless. Therefore, the conclusion is: either we will be destroyed by AI, or we will become a super civilization.

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THE FUTURE OF NATURAL LANGUAGE PROCESSING

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Keywords: Natural Language Processing, Data Science, BERT, GPT

Introduction. Natural Language Processing (NLP) – is a subfield of linguistics, computer science, data science, and is closely related to Artificial Intelligence. It corresponds to processing a large corpus of texts written by people, for example, books, comments on the internet, different documents, scientific researches, etc.

Objectives. In this paper, I'd like to elaborate on current and future researches and achievements in the NLP domain.

Methods. NLP is a helpful tool for computers in solving numerous problems such as:

- sentimental analysis;
- named entity recognition;
- machine translation;
- classification;
- text summarization;
- text generation;

– question answering.

The aforementioned problems can be solved by using deep neural networks.

Modern neural network architecture transformer is the most popular in solving most tasks of NLP. The transformer is based on the self-attention method, which increases speed and accuracy in all tasks compared to recurrent neural networks (RNN) and long short-term memory (LSTM). As an example, leading companies Google and Open-AI create their own deep neural networks based on transformer architecture. Even more, Google has created Bidirectional Encoder Representations from Transformers (BERT). In turn, Open-AI has created a Generative Pre-Trained Transformer (GPT). They are truly worth our attention because of their massive size, namely, they have more than 100 billion machine learning parameters.

Results. Neural network BERT today is state-of-the-art technology in sentimental analysis, named entity recognition and question answering. For example, BERT can recognize named entity with accuracy 90%. As well, GPT is the best in-text summarization system, which can generate text like humans. For a mediocre observer, it's hard to recognize whether the text is written by a human or a machine.

Conclusion. NLP is a very important field in making interactions between computers and humans on a high level, automating processing text, and improving natural language understanding with the help of the machine.

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5G AND ITS IMPACT ON THE INTERNET OF THINGS

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Key words: Internet of Things, 5G connection, device, automation

Introduction. 5G, or the fifth generation of mobile technology, and the Internet of Things (IoT) are two macro technologies rapidly moving to real-world applications. Every day we use multiple devices that keep becoming more and more complicated and are able to execute different tasks. Internet is considered to be one of the greatest inventions of humanity and in conjunction with other technologies and devices it impacts our daily life more than we think it does.

Objectives. The main task is to conduct research for how 5G mobile connection influences Internet of Things.

Methods. The term "Internet of things" (IoT) was coined by Kevin Ashton of Procter & Gamble and it refers to the ability of different physical devices, embedded with sensors, software, and other technologies, to be connected to the internet for the purpose of collecting and sharing data with other related devices. IoT

devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally.

Results. Generally, IoT devices are those that can communicate with the network without human interaction. The examples of such devices are heart monitor implants, home automation technology or a simple fitness band. IoT technology is growing rapidly and becoming more and more mobile. According to Statista Research Department, by the end of 2020 there will be over 30 billion connected devices.

Therefore, we need more capacity for multiple devices to be used simultaneously in the same area. This can be achieved by using a 5G technology, or the fifth-generation of mobile wireless communications, which can handle much more devices than a 4G does. According to Forbes, 5G is expected to offer greater stability, the ability to connect more devices simultaneously, and move more data thanks to faster speeds. The estimated speed is up to 2.7 times faster than the speed of 4G, meaning that 5G connection is supposed to reach up to 1500 Mbps. Not only does it mean that we will be able to download movies in a second, but it also means that big companies will be able to manage data easily and create faster services.

Talking about IoT, 5G connectivity will allow a single-use device (e.g. a water leak sensor) to fulfil digitally automated services (e.g. detecting a leak and sending a notification to a regulator, which will shut the valve of).

Conclusion. All in all, 5G is going to allow creating an entire ecosystem of fully connected intelligent sensors and devices. This has a potential to create new services to enhance the lives of people. A breakthrough would be an IoT-equipped city powered by 5G. By integrating artificial intelligence and connected digital devices, it will be possible to make adjustments to traffic flows, increasing safety and protecting the environment.

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DECRYPTING ANCIENT LANGUAGES USING MACHINE LEARNING

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Key words. Machine learning, artificial intelligence, linguistics, decryption

Introduction. There are dozens of unspoken for centuries or even thousand years' languages in the world with no information about their vocabulary, grammar or syntax. Unfortunately, very few texts have survived, so that it became even harder to study them thoroughly. If we had more written evidence of ancient culture, we would be able to pick up quite a bit of knowledge. What is more, if we learn the language of earliest civilizations, we will understand them better: what kind of people they were, what they believed in and worshipped for, their lifestyle, customs and traditions. Nowadays, it has become possible to decrypt those ancient inscriptions, using the benefits of modern information technology.

Objectives. Artificial intelligence (AI) is a tool that demonstrates huge significance in the decoding of languages. Its basic work is to point up 4 distinct things related to letters and characters and then create monotonic character mapping, distributional similarity and significant cognate overlap.

Over the past decade, Google Translate automatic text translation system has expanded from recognizing several languages to 103, and now it translates nearly 140 billion words per day. This September, it was reported that the developers had decided to fully refactor the Google Translate service so that it will use only deep learning techniques. There are many additional benefits to this approach. The translation is getting much better and much more precise. As a result, the system can translate texts written in languages which the system has never seen before. Nevertheless, conventional machine translation algorithms, for example, which Google Translate uses nowadays, cannot be utilized since provided data is insufficient. Furthermore, some of these ancient written works even lack familiar delimiters such as spaces and punctuation marks.

Methods. However, researchers from the Computer Science and Artificial Intelligence Laboratory (CSAIL) have presented a system that can automatically decrypt a lost language without requiring in-depth knowledge of it and its relationship to other languages. Besides, the system can determine the relationship between languages.

The work of the system is based on the essential principles of linguistics. For instance, experts who studied ancient languages concluded that the letter "p" in words may eventually change to "b" over the time. The decryption algorithm learns to embed the sounds of the language into a multidimensional space, where differences in pronunciation are reflected as the distance between the corresponding vectors. That is how the patterns of language mutations are detected and recorded. The model can segment words of ancient language and compare them with relative ones in similar modern language.

The algorithm allows you to assess the proximity between two languages. In fact, when tested in known languages, it can even pinpoint language families precisely. The

team applied their algorithm to the Iberian language, considering possible affinities with Basque, as well as less likely candidates from Germanic and Turkic families. Although Basque and Latin were closer to Iberian than other languages, they were too different to be considered related.

Results. As a result, the decrypting approach based on related words is expected to broaden. It will include defining the semantic meaning of words. For example, in a text, you can identify all references and mentions of people and places, and then examine them using historical evidence to find out what particular marked word means. The approach can be applied without any training data of the studied ancient language.

Conclusion. To sum up, Artificial Intelligence has been used to decipher ancient languages due to the fact that there may be important facts in the advancements of those civilizations. While it was believed that a lost language cannot be recovered, now it is possible not only to decipher a lost language but also to translate it into other known languages. Nevertheless, it is important to realize that a lost language equals a lost civilization, and AI can play a great role in protecting them.

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EXTENDED REALITY: THE WHOLE WORLD IN ONE ROOM

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Key words: extended reality, immersive technologies, augmented reality, virtual reality, mixed reality

Introduction. Meeting in New York, concert in Berlin, dinner on Mars, and all this without leaving your flat in Kyiv. Sounds like a fantasy? No more! Extended reality (XR) makes it possible anytime and anywhere. XR is an umbrella term using for all immersive technologies that allow us to mix our reality with virtual. These technologies collect data about objects in a specific place at a specific time and convert it into a holographic image, creating an imitation of your presence in that place. From interactively identifying constellations to walking on the Moon: you can do all of it.

Objectives. The main goal is the development of immersive technologies, mass production, and implementation in all spheres of life. Now, this is especially actual in connection with the spread of COVID-19 and self-isolation because with help of these technologies you can study, work and develop culturally without leaving your home and without endangering yourself and others.

Methods. Today, there are 3 ways to interact with another reality: augmented reality (AR), virtual reality (VR), mixed reality (MR).

AR allows overlay virtual objects in the real world, not limiting interaction with the environment. It is enough just to have a device with a camera (for instance, a smartphone or tablet) to use this technology, although special AR glasses are also available. Augmented reality is the most studied and widely used at the moment. The main direction in its development is writing applications that support this technology.

VR, unlike AR, immerses a person in a completely new, technically created digital environment, leaving no connection with real life. Interaction with that world happens by using a special helmet and controllers. At the moment, of the five senses, conveying sound and image is the best, the possibility of conveying tactile sensations and smell is inactive exploring, but now it is impossible to convey taste.

MR, as the name suggests, is a mix of augmented reality and virtual reality. It, like AR, overlays an image on existing reality and, like VR, allows you to interact with elements in physical space. This technology has been studied the least, but it provides the greatest opportunities. The main attention in researches should be paid to finding cheaper production options, reliable methods of protecting information, ways to display virtual objects so that they are indistinguishable from real ones.

Results. The most successful company that develops extended reality is Accenture. Head of this organization, Raffaella Camera, said: “The Accenture XR practice is continuously exploring ways to reimagine how people and organizations alike interact with the world around them through the latest immersive technologies. Our XR Event Planner is a prime example of this principle in action, with the potential to fundamentally transform how the event planning industry operates.” Another recent development, together with Kellogg’s and Qualcomm, is a virtual prototype of the store: thus, by tracking the eyes moves of customers, they found the most profitable variants for placing, assortment, and promoting a new product – Pop Tarts Bites. Microsoft’s HoloLens is a great example of mixed reality: the device lets you place digital objects in a room and interact with them in any way you can. The additional reality is used by shops to enable customers to “try on” things in their real homes. Companies like Wayfarer and IKEA use this technology. In our daily life, we constantly face AR on Instagram and Snapchat, applying different masks to selfies. Extended reality systems are researching and manufacturing by companies such as HTC, Facebook, Microsoft, Sony, Google, and Samsung.

Conclusion. Extended reality is a mix of augmented reality, virtual reality, and mixed reality (in the proportion of 36%, 38%, and 26%, respectively), which opens up a new vision of the environment. It mixes the real world with the virtual, creating an atmosphere of the presence of anything and anyone anywhere in the world. XR is a fast-growing field that is applied in a wide variety of spheres of life, such as remote work, study, entertainment, marketing.

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SYNTHETIC BIOLOGY OR HOW TO PROGRAM THE CELL OF A LIVING ORGANISM

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Key words: synthetic biology, living organisms, programmer

Introduction. Today, more and more computer scientists are turning their attention to the researches related to biology. There is nothing strange in this, because even for example of DNA, the possibility of imposing the main programming paradigms (abstraction, standardization and automation) on the methods of studying biological objects is clearly visible (Greshnova, 2018).

Objectives. Based on this, a new scientific direction appeared – synthetic biology. The main task of it is the creation of biological machines for solving practical problems. For better understanding what this science is and how biology and programming are intertwined in it, let's consider how a programmer sees DNA.

Methods. First of all, for living organisms, DNA is an information carrier, but through the eyes of a programmer this is a program code, while living organisms are nothing more than executors of these programs that call the desired function depending on the received signal. Due to the versatility of the genetic code, genetic programs can be compatible with most living organisms.

Secondly, it is also fairly easy to describe biological processes using logical expressions. Let us illustrate this with the example of the lactose operon. Operon gene expression is inactive in the presence of glucose, and in its absence, it is active. Using logical operators, it will look like this: NOT (A) = B, where A acts as glucose, and B is the expression of genes of the lactose operon (Greshnova, 2018).

Moreover, this is a fairly young science but there are already some successes associated with the new generation sequencing method. This new method allows you to

read a huge number of DNA fragments in a parallel. In 2003, a group of researchers succeeded in synthesizing the genomic DNA of a bacteriophage, and in 2008 a complete bacterial genome was synthesized.

Results. Finally, scientists in the field of synthetic biology are now thinking about creating living organisms with a fully synthetic genome. But there are several challenges on their way to building high-level systems. The main one is that it is almost impossible to predict the behavior of a system with a large number of components due to the complexity of the connections that unite the cellular components. But promising directions for solving this problem have already been found. For example, one of such solutions is systems based on RNA-RNA interactions (Onishchenko, Kuttyrev, Odynokov, Safronov, 2014).

Conclusion. To sum up, during the time that synthetic biology has existed, it was able to show that using engineering approaches to working with biological objects, it is possible to find more effective solutions in the fields of medicine, pharmaceuticals, bioengineering and biotechnology. Perhaps, soon no one will be surprised at the programming of living organisms, and the development of biocomputers will allow them to execute programs of any complexity.

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EL NINO SOUTHERN OSCILLATION

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Keywords: ENSO, SSTA, variability, models, PO

Introduction. ENSO or El Nino Southern Oscillation is the long-observed combination of effects in atmosphere and water above and under surface of Pacific Ocean (PO). Convectional condition in PO is characterized by warm temperature in west parts and cold on the east. However, some external events can initiate spatial changes in surface water distribution and subsequent phenomena that known as Sea Surface Temperature Anomalies (SSTA) is recognized as onset of ENSO. This will lead to changes in the weather season in Australia, Peru, East China and Indonesia. Trade winds above PO will be suppressed and vast amount of moist air will be redirected from Australia coast to west Peru coast that usually cause massive flooding in equatorial South America's parts while also cause droughts in Australia.

Objectives. Main task is to provide information about ENSO and its variability whereas describe and characterize current condition of forecasting models for ENSO

events. Additional task is to provide information about new types of ENSOs events and define changes in their amplitude and frequencies.

Methods. Existing models can be divided in two groups – for ENSO phenomena occurrence predictions and models for ENSO's conduct or in other words groups for phase of onset and group for phase of mature and demise. First group analyses reasons and mentioned above external phenomena in of-equator area.

Results. There are several main models for this purpose that highlight some of stochastic processes in atmosphere and water and conduct one of the events as leading in creating SSTA. For example, near polar currents and connected with its simultaneous rising of average temperature (discharge-recharge model) or extend effects of wave-like changes in average sea surface height (delayed-oscillation model). All models from this group can successfully identify some but not all aspects of ENSO and to have full information it is necessary to work with output of each model in interplay among all of them.

Second group of models is built on statistic knowledge about physical aspects of every ENSOs and its dependents on starting condition and commonalities with other such events. In order to specify future characteristic of upcoming phenomena scientists use empirical orthogonal function or EOF that operate on different timescale so called quisi-2 and quise-4 years' timescale. They have successfully shown their relevance in realist prediction.

Although of effectivity of all mentioned methods, scientist still struggle to give fully correct forecast about amplitude and magnitude of ENSO events. Climate changing has already significantly changed main part of SSTA – place where it starts. To cope with such problems, existing models have been changed in order to fully agree with observed events. Extra phenomena and feedback loops were added to models – such as multiplicative noise or westerly wind events (WWEs)

New mixed models have improved predictivity ability of math models and extra non-linear component in models' equations can finally explain every part of onset and evolution of ENSO.

Conclusion. Understanding of ENSO is important achievement of modern science since such events affect climate in many high-populated regions of the Earth. Also created in process system can give us better understanding of climate change impact on the weather worldwide and help us to achieve correct weather forecast in general.

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OPTIMIZATION OF DATA TRANSFER IN RELATIONAL REPRESENTATION

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Key words: data transfer, serialization format, relational data representation

Introduction. The sphere of software development has become widespread in modern life for all business lines, especially with big dataflow. For now, leading companies order informational systems for customers, like CRM, business process management software, like ERP and workflow-based programs. Whatever purpose of the program may be, any software involves data transfer between its components or services. Nowadays, it is vital for distributed systems, web applications and applications with microservices architecture that make up for the majority of the software market. That's why, nowadays, the data transfer optimization is one of the most relevant topics for modern software technologies.

Objectives. The main task is to introduce new optimized method of transferring data in relational representation.

Methods. The general structure of the data transfer format proposed includes signature, data and metadata. The signature is 16-bytes blocks which contains description of corresponding unit: its type (metadata, data, dataset begging or end), size and others (which differ depending on block type). It leads any block of data or metadata. The metadata unit represents a specification of data field which corresponds to a property of relational entity. It contains the name of the data field and a flag defining if the field is not scalar but a link to another dataset. The data is an array in binary json format containing values of an entity in strict metadata-specified order, called data record. In order to reduce the size of transferring data, the data record fields' count per unit may be less than it is declared in corresponding metadata unit, facilitating not to transfer empty or non-existing values. Unlike popular XML and JSON formats, metadata of the similar entities should be described once and all the entities data should follow the metadata immediately one by one. That is what helps to significantly save memory and transfer time during the communication between different components. To the point, these indicators are the most critical for data transfer over HTTP that is used almost for all web-services.

Results. The format described stands out from the core technologies. It is designed in a way that lets to save up near 30% of transmitted data and is friendly to parallel processing.

Conclusion. To sum up, the optimization of transferring data in relational representation contributes to economic and performance benefits, including transporting and equipment costs. The application area of the format proposed is not restricted neither by purpose nor technologies used.

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RESEARCH AND IMPLEMENTATION OF IOT PROJECTS FOR ENERGY RESOURCE METERING

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Key words: IoT; energy resource metering; automation; OCR; ESP32; Tesseract

Introduction. Today the value of time is very high and people try to make all processes automatic. At the moment, there are a large number of old buildings in Ukraine, where we can find old telecommunications systems, fire systems, security systems as well as water supply, gas supply, electricity, etc. The use of these resources is controlled by counters. In addition, the old counters do not have the ability to transmit data. That is why most people in Ukraine cannot pay their bills for water and gas automatically, they have to fill in writing forms. It takes a long time. So we have to do the process of getting metrics automatically.

Objectives. The main task is to do the process of getting metrics from counters automatically and design cost-effective IoT solutions for Ukraine needs that could be useful for the rest of the world.

Methods. We can replace the old counters with new resource metering devices that have some interface for data transmission, but it is expensive and there are many bureaucratic issues. Therefore, we have the following scheme:

- Camera takes a photo of water meter at specific moment of time.
- Transceiver ESP32 with WiFi interface receives the photo from camera, saves into the file and send it to the server for optical character recognition (OCR) processing.
- Telecommunication infrastructure transmits data between the transceiver and OCR processing center.
- OCR processing center processes photos and stores the data in proper form (text or database). For the testbed, the Raspberry Pi 3 Model B with Tesseract libraries are used; any machine learning / python libraries or other tools can be used to improve test recognition. And in the end, users can get their information to smartphones (Uryvsky, Gerstacker, Moshynska, Osypchuk, & Yatsyshyn, 2020).

Results. We can make the process of obtaining information from the meter comfortable and fast. Also, this method is convenient for implementation in Ukrainian buildings.

Conclusion. This method is very effective for most Ukrainian buildings and it is cheap to design. The advantage of this method is that you do not need to obtain any special permits.

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NEW OPPORTUNITIES IN MARKET RESEARCH IN THE CONTEXT OF DIGITALIZATION

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Key words: digitalization, market research, information technology

Introduction. Even the best professionals are not able to process the amount of information we have today, so that's where digital technologies come to help. They improve existing methods and open new opportunities. Because of this, it is extremely important to monitor these changes because in today's world they occur very quickly and have a significant impact on the effective functioning of the commodity market.

Objective. The purpose of this work is to assess the impact of digitalization on the methods and stages of research of the commodity market. Before considering its specific methods and stages, we propose to determine the terms that we will use in the study. So, the market is a set of currency relations, acts of purchase and sale of goods and services, a way of interaction between producers and consumers, which is a mechanism for the distribution of goods and services between members of society through voluntary exchange and pricing. As for the market research process, it is a process that contains a set of tools and systematic actions aimed at collecting and analyzing information about the status, structure, and customers. In addition, market research provides information on market needs (needs of its customers), market size and competition. In most cases, statistical and analytical methods are used to obtain such information. Digitalization is a process of widespread implementation of digital technologies in social life.

Methods. Common methods of market research include: surveys, focus groups, in-depth interviews, field research or experiments, observations. In the general case, market analysis, regardless of its type (structure, consumer, price analysis, segment analysis) consists of similar stages. They are: determining market size, growth dynamics and sales potential; identifying key "players" and conducting competitive analysis for each of them (compare the range, prices, communication, places and methods of sale and product quality). Determining competitive advantages; analysis of the main product segments. Determining the dynamics of their growth and potential; analyzing the places and methods of selling goods on the market; conduct a comparative analysis of methods of promoting goods on the market; assessment of the level and structure of prices (cost, margin, advertising costs, profits) in the market. Dividing "players" into segments by price; evaluation of consumer satisfaction with goods; estimation for market trends for the next few years.

Results. The research of the first stage provided an opportunity to find out that determining the size of the market has become much easier with the increase in the use of information and digital technologies. The Internet provides the ability to use public APIs (Application Programming Interfaces) to determine the number of customers of certain stores or manufacturers of goods. If public APIs are not available, we can use the "scraping" method for the websites of these stores and manufacturers. In this way,

we can get information about the number of customers or buyers and determine sales potential. At the same time, no one forbids the use of classical methods of analysis, such as the use of statistics collected by research companies or government agencies. As for the next stage, competitive analysis can be accelerated and facilitated by the use of software regression methods or even machine learning, which may formulate more accurate conclusions than humans would. The advantages of digitalization over the third stage are similar. It is a well-known fact that people are more willing to take an anonymous survey online than live. Thus, there will be more data for analysis, and therefore the results of the analysis will be more accurate. That is why the method of research through surveys becomes more effective in determining the places and methods of selling goods. The impact of digitalization for the fifth stage is similar to those already listed earlier. For the sixth stage, there is almost no impact: it is a slight acceleration of the calculations. In this case, the advantage of digitalization is as follows: the availability of comments on sites as a method of communication between consumers and between consumers and the store, online surveys and the ability to programmatically analyze them. As in the fourth stage, a larger sample guarantees greater accuracy and representativeness of the results. Machine learning and artificial intelligence can be used to predict market trends.

Conclusion. Thus, now we are ready to draw some conclusions. Firstly, digitalization has radically changed the method of the survey, ensuring its maximum efficiency. Nevertheless, the method of experiments and field research are not affected. Secondly, it has taken almost every stage of market analysis to a new level, giving new opportunities for access to information and its processing. Thus, we can say that market research in the context of digitalization is becoming more comprehensive and productive.

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IP ADDRESS SPACE EXHAUSTION

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Keywords: IPv4 address, public address, NAT, private networks

Introduction. The Internet is the most popular public network in the world that claims to have more than 4 billions users(Douglas, 2006), the most popular model for nowadays network deploying is TCP/IP and it is used for the Internet as origin stack of protocols, the problem is that IP(protocol) is limited by a number of users that can get their unique address and this limit has been gone beyond. So the question is how the Internet still functions, provides access to thousands of users and spans more places each day.

Objectives. The main task of research is to find out technical solutions that are used in modern networks for logical addressing to avoid possible problems in the future in personal and public networks that scale swiftly every day.

Methods. There two main solutions to solve the problem of address space exhaustion (Lammle, 2003).

Network address translation (NAT) is a technique that provides remapping address space, which in simplest implementation replaces one address with another one. Here is important to mention how current addressing works. In IPv4 network we use, what it is called Classless Inter-Domain Routing(CIDR), where we have an IP address and a mask that determine what part of the IP is address of a network and what is a host address. For NAT propose we have three ranges of IPs that cannot be reached from the Internet and it is what we call private addresses, so the other ranges it is public IPs and they can be reached from outside a local network. When host with a private IP want to communicate with another one in a another network, NAT replace his private IP address with a public, so the reply will come to the public IP and NAT again will replace it with the private. The method that is often used in personal propose called PAT or overloaded NAT, where every host in the network can be reached from public network by public IP address and by using a unique port of destination.

IPv6 is the replacement of the IPv4 protocol, which solves the problem of address space exhaustion by simply increasing this range. In the context of current research, IPv6 differs from IPv4 by the length of address; IPv6 has 128-bits per one when IPv4 has 32. This increases the number of possible addresses up to 2 in power 128, which is enough to cover current and future humans needs.

Results. Nowadays we are not suffering from the problem of address space, NAT provides us with a solution that utilizes IPv4 an available range when IPv6 is going to replace IPv4 step by step. First of all, vendors will provide their devices with dual-stack protocols that will support all IPv4 and IPv6. Then more and more network will use IPv6 and IPv4 will be stated as obsolete technology.

Conclusion. Today we fully utilize the range of available IPv4 addresses using vast of methods and technologies. It is important for future development to create

effective methods that will provide IPv6 only networking, also it is important to create standards that will support this technology.

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INTELLIGENT INFORMATION SYSTEM AND ARTIFICIAL INTELLIGENCE IN DAILY LIFE

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Key words: artificial intelligence, intelligent information system, smart home, smartphone

Introduction. In recent years' information systems have become an integral part of our life to facilitate the management and organization of various kinds of information. Modern technology, containing signs of artificial intelligence, has become a common everyday means of increasing the level of comfort and safety. Due to rapid technology development it has led to the emergence of information systems of a new type called intelligent information systems, which are based on knowledge, or a complex of software, logical, mathematical and linguistic means to support human activities and search for information in the mode of ensuring a dialogue between computers and the user by means of natural language.

Objectives. The main task is to track the use of intelligent information systems and artificial intelligence in the daily life of each of us, to clarify and show how close modern technologies are to us, much closer than we think.

Methods. At the present stage of development of the information society, a significant place among software products to meet the information needs of users is taken by information systems, which are defined as applied software subsystems focused on the search, collection, storage and processing of the text and factual information. The most popular tool for managing personal data and personal information is our smartphone. Artificial intelligence is an integral part of the smartphone. With the development of artificial intelligence, the technical capabilities of the phone also increase. For a long time, the technical part has not been as important as the algorithms themselves and programming and the possibilities of artificial intelligence when working with technology.

Results. Smartphone takes part in the work of the most elementary things. Users are already accustomed to unconsciously using virtual assistants to quickly fulfill their usual daily needs: to set an alarm, ask to remind about an important event, ask about the weather, and just a conversation with such a virtual assistant no longer surprises anyone. Nowadays developers also pay a lot of attention to tracking user's health. In conjunction

with a smartphone, a watch may have sensors for measuring heart rate, oxygen in the blood and an accelerometer to cut off movement, so artificial intelligence can predict well-being. If something goes wrong and unusual indications of a change in health are observed, the watch sends a signal and the system notifying the hospital to provide the necessary medical care.

In our time, all things around us form a network of communication among themselves for our convenience. This is called the concept of a smart home. So with the help of the voice assistant of your smartphone, you can control the technology around us. For example, connect your smartphone with speakers throughout the house and a virtual assistant will hear all your commands from any corner of the room. And this is no longer an episode of a futuristic film. Such a smart home control system using only voice commands will help people with disabilities easily use their home electronic devices without making unnecessary movements to turn them on or off, especially for the much-needed lighting and communication with the outside world.

Conclusion. Everything around us tends to get smart every day. With such statistics, the danger of the safety of personal data increases in direct proportion. Therefore, having decent security software is the biggest need these days. New technologies for implementation in large masses must work reliably and intuitively, have a huge guarantee and last a long time in order to become popular.

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USING INTERNET OF THINGS DEVICES TO PERFORM EDGE COMPUTING IN DATA SCIENCE

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Key words: internet of things, edge computing, data science, computations, system on a chip

Introduction. The evolution of data science requires more computational capacity with every day. We need to process large amount of data to conduct research, but we also required to use a substantial amount of our resources to sustain already established infrastructure. Edge computing plays an essential role in unloading our networks, but it is only a special solution. We need to find a way to conduct computation for research in data science and devices that uses data science algorithm in a way that will further decrease the load on the collective network.

Objectives. The goal of this work is to offer to transfer part of the computational load into local networks so that collective servers will do less operation and be called

less frequently. That way we will be able to save server's time for more important calculation that cannot, or are not recommended to, be performed anywhere else.

Methods. The primary method of research used in this work were studying the literature and practical application of the technology in question. Then based on the found information a simple solution was discovered.

Results. It was found that most of Internet of Things devices in the ownership of the user can perform complicated enough operation and there is no necessity to transfer it to the cloud other than to save time. By distributing the calculations onto devices of the same network we can both save global network bandwidth and perform the operation as fast as the task required.

The solution is based on the fact that there is an excess of idle Systems on Chip that is present in users' local network in forms of devices of the Internet of Things such as smart bulbs, smartwatches or smart TV boxes that started to become part of our homes in recent years.

Additionally, more complicated devices, such as smart TV or even laptops, already loaded with an operating system that supports modern programming language, meaning that we can create a Python Script for those devices that will work the same on all devices. Unfortunately, there are still some devices that will require bare-metal programming, and thus might not be economically profitable for our cause.

Another drawback is that those devices have relatively small memory capacity and thus are unsuitable for very heavy computational, so frequently used in Data Science. But this can be solved by dividing the main computational task into smaller parts, albeit it requires additional consideration — because of the added time, some tasks might be inefficient to calculate in that way even still.

Conclusion. Using Internet of Things devices to perform edge computing becomes a good solution for the problem of overloading the network channels and growing lack of computational powers, although it requires careful consideration which task can be performed locally and which are better to be sent to a cloud server.

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ANALYSIS OF SECURITY OF COMPUTER NETWORKS

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Keywords: vulnerabilities, exploits, BlueBorne, EternalBlue

Introduction. With the rapid development of computer technology, the growth of the pace Software development has the problem of a large number of vulnerabilities in

the final product. Some of them have existed for almost 20 years and have not been noticed by the developers.

Objectives. Describe the attacks by BlueBorne, EternalBlue, Stagefright and WinRARPathTraversal vulnerability

Methods. BlueBorne attack is possible when Bluetooth is on today is not uncommon. Particularly vulnerable to this attack phones of 2017 (Staff, 2017). EternalBlue is an attack that has been effective on Windows since WindowsXP version up to and including WindowsServer 2016. It is believed that this attack was developed by the NSA, and the details of the attack were published by the hacker group TheShadowBrokers on April 14, 2017 (Biggs, 2017). The WannaCry virus, which used the attack, later spread. The attack exploits vulnerabilities in the SMB protocol.

The Stagefright bug was discovered by Joshua Drake from the Zimperium security firm, and was publicly announced for the first time on July 27, 2015. Prior to the announcement, Drake reported the bug to Google in April 2015, which incorporated a related bugfix into its internal source code repositories two days after the report. In July 2015, Evgeny Legerov, a Moscow-based security researcher, announced that he had found at least two similar heap overflow zero-day vulnerabilities in the Stagefright library, claiming at the same time that the library has been already exploited for a while. Legerov also confirmed that the vulnerabilities he discovered become unexploitable by applying the patches Drake submitted to Google.

WinRARPathTraversal – imperfection of software WinRAR, which made it possible to forcibly unzip the archive to a directory specified by the attacking party. This vulnerability has existed for 19 years, but the details were first published on February 20, 2019.

Results. The greatest success in achieving this goal has been achieved by Apple, Google, Microsoft and Linux. They have done a lot of work to improve their systems and made many updates to prevent this vulnerability.

Conclusion. In conclusion, we can state that nowadays, there are many malicious programs that we may not be aware of, but they make our software vulnerable.

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BLOCKCHAIN TECHNOLOGY IN CYBERSECURITY

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Key words: blockchain, cybersecurity, cyber risks, issues

Introduction. Nowadays, with a rapid development of the information technologies, not only an unlimited number of opportunities appeared, but also risks. That is why cybersecurity is one of the most demanded areas in IT and one of its tools is blockchain.

Objectives. The main task is to conduct research on the use of blockchain technology to ensure security and prevent any kind of risks, including identity theft.

Methods. Blockchain is a technology that divides cryptographically signed transactions into continuous sequential chain of blocks (linked list), built according to certain rules (using cryptography), containing: previous block's cryptographic hash, timestamp and data. To change the information in a block, it's essential to change one in all subsequent. Usually copies of blockchains are stored independently on many different computers or servers. This makes it extremely difficult to change the information already included in the blocks.

Results. Firstly, blockchain was invented to provide reliable transactions for the bitcoin cryptocurrency, but over the 12 years of its existence, the application of the technology has expanded significantly. Now it is used to maintain: smart contracts, identification and verification, public records, including property registries, and especially applications in which it is necessary to support the sharing of verified data between users who are geographically far from each other.

Blockchain security measures differ depending on each individual application, but usually includes:

- encryption by public-private key method to control access of participants.
- protection of the integrity of transactional data within blocks using cryptographic hashes. Technology also records blocks in chronological order, reliably tying each block to the previous and following blocks. This measure:
 - prevents data tampering within a block due to any attempt to change data, changes hash values, and other participants can quickly detect it; as well as it
 - provides the immutability principle widely advertised for transactions recorded using blockchain.

Specific blockchain applications can use different security measures which affect. Potential users should and understand the specific measures the blockchain application uses to avoid unexpected vulnerabilities. Private blockchains require increased attention because they may not have a reliable network user, which is necessary to track attempts to intentionally or mistakenly introduce erroneous data into the blockchain.

Blockchain technology provides a more reliable method of securing an online ledger of transactions than traditional centralized computing services. For instance:

- Cyberattacks usually prefer to attack centralized databases, which, once compromised, infect and destabilize entire systems. Distributed ledger technologies increase cyber resilience because there is no single point of failure. An attack on one or a small number of participants does not affect other nodes, which can:
 - maintain the integrity and availability of the register; as well as keep doing deals with each other.
 - the increased transparency of distributed ledgers makes it harder for cyberattacks to damage blockchains through malware or manipulative actions. Each node contains an identical copy of the ledger, so participants can quickly detect any attempt to damage or improperly alter the historical record of a transaction. The

encryption technologies that blockchain applications use to create and link blocks of data protect individual transactions and the entire ledger.

– consensus mechanisms similarly protect new blocks of data by requiring network participants to validate and continually compare them with past transactions, making it less likely that a cyberattack or fraudulent organization is improperly manipulating new blocks of the ledger.

Conclusion. To sum up, blockchain technology has not only introduced the world bitcoin, but it also turned out to be a revolutionary new way to ensure the reliability, integrity, availability of information, and also guarantees confidentiality, that is, information will not be obtained by third parties.

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PRINCIPLES OF BUILDING AN INFORMATION RISK MANAGEMENT SYSTEM

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Key words: information risks, information security, information risk management system, information security management system

Introduction. The information risk management system is the foundation on which the organization's information security management system is built.

Objectives. This is the most important and, at the same time, the most difficult to implement of all the subsystems that make up the information security management system.

Methods. We should also not forget about the goals of risk management, ways to assess the achievement of these goals, methods of measuring the effectiveness of control mechanisms and personnel incentive system, which should be associated with achieving the goals of information risk management and effectiveness of implemented control mechanisms.

The task of optimizing the costs of improving the information risk management system is to determine such a set of tools to combat information risks, which would

provide a minimum amount of projected total costs for information risk management. The solution to this problem is to identify those controls that need to be replaced or upgraded that simplify the incident response process and reduce the amount of human intervention required to address security cases, as well as to select (create) new mechanisms to introduce them into the information management system. risks in order to obtain an optimal information risk management system.

Therefore, the development and implementation of information risk management system – a very time-consuming process that requires high professionalism and extensive experience in risk management. Theoretically, every organization that begins to realize its needs for information security, is able to move towards creating a system of information risk management on their own, but in practice many go into a dead end on this path.

Results. Therefore, to ensure the appropriate level of information security, it is necessary to build a system of information risk management, monitor and support it, which will allow the effective use of a combination of all possible tools and methods.

Conclusion. To do this, it is necessary to comply with the requirements specified in the standards for information security and risk assessment.

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SECURITY OF TRANSACTION BANKING

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Key words: Banking transaction, cybersecurity, bank platform, financial services

Introduction. Transaction banking is one of the pillars of our current banking world (Rahmel, 2017). Nowadays, we use mobile phone and POS terminal for performing transaction. As business has digitalized, and it makes a new threat to appear. This threat is widespread, and is in global level. According the report WTO (World Trade Organization), it is estimated that cybercrime costs the global economy more than \$400 billion a year, and in 2019, it has been increased to \$2.1 trillion (Deutsche Bank & Global Transaction Banking).

Objectives. Let's make quick analyze about challenges/problem, that transaction banking has to be faced with.

1. **Online Payment Frauds** (Arunachalam, 2019). Bank customers are allowed to created virtual card, which is based on customer's original card. Cyber hackers target is make “hole” in system and steal virtual card's details. After that, they can perform transaction without card's owner permission.

2. **Triangulation** (Arunachalam, 2019). There are fake portal or fake platform was created for deceiving customer and stealing Bank account details. Once you make

order in the fake portal, they automatically steal bank account's details. And hacker can perform transaction without card's owner permission.

3. **Fraud diversification** (Deutsche Bank & Global Transaction Banking). Currently, corporate employees are still insufficiently aware of how genuinely ubiquitous "social engineering" cyberattacks are. One of the main ways is manipulating an organization's staff. They may trick them into downloading malware onto the company's systems, opening these up to criminal control or into directly revealing information.

Methods. To prevent cyberattack, let's split the method to solve the into 3 part: for governance, for process, for staff training.

Governance

1. Establish a cybersecurity framework linked to the corporate governance structure.

2. Write clear policies for Data Protection, Payments and Counterparties, that define risks and acceptable behaviours.

Process

1. Require two-factor authentication for login.

2. Require two-factor authentication for payment release (based on a physical or software app token).

Staff straining and awareness

1. Establish and regularly refresh cybersecurity awareness training for all employees.

2. Execute social engineering fraud rehearsals, e.g. by simulating phishing, vishing, fake president attacks, etc. to see how employees react.

Results. There is growing momentum for using handheld devices as separate channels for out-of-band authentication, which allow a transaction to be visualized and authorized via a separate channel e.g. a mobile phone. Such methods of authentication might include voice or facial recognition (e.g. via 'selfies'), fingerprints, iris or finger-vein/bloodflow scanning – or a combination of factors as in the password-free. (Deutsche Bank & Global Transaction Banking)

Conclusion. Corporates cannot afford to hold back on cybersecurity – they need to prioritize and invest in it now. While technological defences remain crucial, we shall increasingly see employees being the unwitting agents of cyberattacks, unless we educate them in how to prevent attacks – that way, they become instrumental in mitigating cyberrisk.

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APPLICATION OF MACHINE LEARNING ALGORITHMS FOR DETECTING PORTABLE EXECUTABLE MALWARE

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Key words: machine learning, data science, algorithms

Introduction. Machine learning is an extensive specialized artificial intelligence that studies methods of teaching algorithms that are capable of learning. Instead of writing code, you pass data to a generic algorithm, and it builds its own logic based on it. The most common algorithms in Machine Learning are classification, clustering, and regression. In our work, we used a classification algorithm to recognize malicious files. The input to the algorithm is data – at the output we get a prediction – the probability that the file is infected or not.

Objectives. The main task is to predict is file infected or not.

Methods. We took dataset for training machine learning models to statically detect malicious Windows portable executable files (.exe). The dataset includes features extracted from 19629 binary files: 19611 training samples (14599 malicious, 5012 benign) and 18 test samples (8 malicious, 10 benign). Before modeling, in order to train the model on the training dataset, we preprocessed it in the following 4 stages:

- filled in empty values in the table, for example with averages;
- categorical signs were turned into binary, using OneHotEncoder or LabelEncoder;
- removed uninformative features, such as file names.

Then, when all the features became binary / numeric or ordinal we scaled them, this had a positive effect on the speed of training models.

After the dataset was preprocessed, we started modeling. (Mauricio, 2018)

Results. We took two datasets, one for training and one for testing. The dimension of the training dataset is 18, the dimension of the test dataset is 78. 19611– the total number of files for training, including benign and malware files. 79 features were taken from the training dataset. All of these files are named portable executable files. All the same signs were extracted from the training dataset.

Finally, let's get down to modeling. We compared the accuracy of 4 models on our data, three of them refer to supervised learning and the last one is unsupervised:

- multi layer perceptron (neural network algorithm);
- random forest (tree-based algorithm);
- support vector classifier;
- k-means.

As a result, we got the following prediction accuracy on cross-validation:

- multi-layer perceptron – 0.9322120285423038;
- random forest classifier – 0.9877675840978594;
- support vector classifier – 0.8129459734964322;
- k-means (without labels) – 0.7697874328267066.

The random forest classifier showed the better result. We used this model to predict the malicious of portable executable files from our test sample. We received the expected result on the test: the accuracy was 0.9411764705882352, it means that only one file out of 17 was predicted incorrectly.

Conclusion. To summarize, the tree-based algorithm has shown good results. The best accuracy was obtained using the random forest classifier. We hope the dataset, code and baseline model will help invigorate machine learning research for malware detection, in much the same way that benchmark datasets have advanced computer vision research.

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DEEP LEARNING VS OTHER COMMON MULTIPLE SEQUENCE ALIGNMENT APPROACHES

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Key words: machine learning, deep learning, multiple sequence alignment

Introduction. Nowadays different computational methods are developed for facilitating advanced calculations. For instance, deep learning techniques are proved to be accurate enough in carrying out the multiple RNA, DNA and protein sequence alignment (MSA). This question is significant in the bioinformatics because it is employed in search of corresponding regions between different species which is important for finding their evolutionary origins and many solutions have been put forward over time (Notredame, 2007). The methods of dynamic programming can easily align two sequences while MSA’s computational overload is too high for them.

On the other hand, progressive approach, that aligns each two sequences from the most similar to the most distant pair. It builds a “guide tree” that presents the sequences’ connections via a clustering system and then adds them to the MSA one by one depending on their position in the tree. Machine learning methods based on feature learning are called deep learning. Deep Artificial Neural Network (ANN) is composed of the artificial neurons that are connected via synapses and act like biological neurons in the animal brain.

Objectives. The main purpose is to research how currently widespread matrix (MAFFT, ClustalΩ) and more recent, based on deep machine learning (RL, DRL,

DLPAlign) approaches deal with the DNA, RNA and protein MSA. Moreover, the aim is to determine more effective (quick and exact) ways of MSA solution.

Methods. MAFFT stands for Multiple Alignment using Fast Fourier Transform. It is built on the progressive alignment. MAFFT's clustering technique features the Fast Fourier Transform. Another thing is that tuples across sequence pairs are estimated for computing a distance matrix.

ClustalΩ (Cluster alignment) starts by comparing each two sequences and ordering them by their likeness. It then computes a distance matrix for every pair. Lastly, a "guide tree" is established using the neighbor-join technique.

QuickProbs 2 is another way to solve the MSA. It applies probabilistic models together with the column-oriented refinement. QuickProbs computes the probability matrices initially and final alignment is enhanced iteratively by using the partition function together with the Markov model for computing the posterior probability matrices for further advancement of the accuracy.

Reinforced Learning (RL) algorithm finds fairly quick and precise MSA. It puts together the Q-learning and a few alignment algorithms' modifications thus achieving the low time complexity.

Jafari, Javidi and Kuchaki (2019) have introduced another way of MSA, similar to the preceding RL but featuring the deep reinforcement learning (DRL). Unlike the RL technique, they have exploited long short-term memory ANNs during the initial step. Then, for further convergence time improvement, the actor-critic logic was applied.

Kuang (2020) has come up with the technique for protein MSA. In this research, convolutional neural networks (CNNs) and bi-directional versions of the long short term memory networks were integrated into the progression approaches. In particular, they were applied in the posterior and distance matrices computation.

Results. DNA and RNA alignments' average column scores were counted after running the given algorithms on the Hepatitis C virus; rat, lemur and opossum; lemur, gorilla and mouse; 469 datasets. Average scores for the protein sequences were received by running the solutions on BALiBASE, SABMark and OXBench datasets.

	MAFFT	RL	DRL	ClustalΩ
Average CS %	63	67.25	67.25	63.75

Table 1: Average Column scores for DNA and RNA MSA (MAFT, RL, DRL, ClusalW)

	MAFFT	ClustalΩ	DLPAlign	QuickProbs
Average CS %	53.74	57.22	63.53	62.61

Table 2: Average Column scores (exact matches/alignment length) for protein MSA (MAFT, ClusalW, DLPAlign and QuickProbs)

In each set the two best-scoring alignment algorithms from each of the sets were identified. Next, the average running time for these algorithms was measured.

	RL	DRL		DLPAlign	QuickProbs
Average Time s	717.5	260.5	Average Time s	13.11	2.09

Table 3: Average running time (s) for DNA and RNA MSA among the best-scoring algorithms (RL and DRL)

Table 4: Average running time (s) for protein MSA among the best-scoring algorithms (DLPAlign and QuickProbs)

As the results have shown, the best optimized MSA algorithm for DNA and RNA among the considered is the DRL. DLPAlign has scored slightly better than the next-best QuickProbs. However, QuickProbs is a lot faster, which makes it the best optimized MSA algorithm for proteins among the considered.

Conclusion. To sum up, the deep learning algorithms (RL, DRL, DLPAlign) show much greater accuracy than the most widespread progressive ones such as ClustalΩ and MAFFT both for the DNA, RNA and protein sequences. However, they sometimes may be slower than their competitors like QuickProbs. Nevertheless, with further technological advance, even more optimal methods might arrive and deep machine learning is a promising approach for the future MSA solutions.

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ENERGY EFFICIENT RESOURCE MANAGEMENT OF DATA CENTERS

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Key words: data center, resource management, energy efficiency

Introduction. Due to the growth of information used and produced by modern information systems, the amount of data processed in data centers is growing. Among the problems that arise in data centers are such as: dynamic distribution of data, resource exhaustion. However, if these problems are solved, then a non-trivial question arises: how to effectively manage energy resources. The more energy resources are expended, the more carbon is released into the air, which is harmful to the environment. Theses consider methods of effective management of energy resources of data centers.

Objectives. To identify effective methods and algorithms for resource management in data centers.

Methods. Between 2000 and 2005, the amount of energy consumed by data centers doubled, and this growth continues to this day. This is due to the increase in the exchange of information in all social networks and beyond. If in 1995 1% of the world's

population used the Internet, now about 50% of people have access to the global network. When managing resources, it should be understood that physical machines in data centers are not always in an active state, but can be in idle or terminated state. Key approaches to improving resource management are scheduling, load balancing and migration.

Results. Typically, the schedule for resources in data centers is based on parameters such as cost, performance, and time. At the same time, a balance is needed to provide quality services. The following algorithms help in this:

- A Compromised-Time-Cost Scheduling Algorithm;
- A Compromised-Time-Cost Scheduling Algorithm;
- Improved cost-based algorithm for task scheduling;
- Multiple QoS constrained Scheduling Strategy of Multi-workflows;
- A Particle–Swarm Optimization based Heuristic for Scheduling;
- Innovative transaction intensive cost-constraint scheduling algorithm

(Bhattacharjee, Khatua, & Roy, 2017).

Load balancing is needed primarily to increase resource availability and productivity. The balancer should consider performance, resource utilization, response time, scalability, bandwidth, and others.

It is also very important to migrate virtual machines from faulty servers to working ones. It is necessary to perform this transfer so as to minimize energy consumption (Zharikov, Rolik & Telenyk, 2017). Three methods are used to migrate virtual machines:

- The Minimization of Migrations policy – the smallest number of virtual machines is transferred to reduce the load on the CPU;
- The Highest Potential Growth policy – transferred those machines that have the lowest CPU load percentage;
- The Random Choice policy (RC) – virtual machines are randomly selected to reduce host load.

Among the ideas that really work is to turn off inactive servers, because they use 70% of the energy compared to those that work.

Conclusion. In general, the need to reduce electricity costs in the operation of data centers is related to environmental issues and the constant growth of information processed. Load balancing, scheduling, and virtual machine migration techniques will help you effectively manage data center resources.

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SMART TECHNOLOGIES IN URBANIZATION ISSUES

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Key words: smart technologies, innovations, development, urbanization

Introduction. Through the last couple of years, there are more and more news about digitalization and innovations or new technologies. We would like to talk about smart technologies, which are developing at an incredible speed every year.

According to the "TechTerm dictionary", SMART stands for "Self-Monitoring Analysis and Reporting Technology." It is used to protect and prevent errors in hard drives. The SMART technology main purpose is to monitor and analyze hard drives, then check the health of it and let the user know if there are any problems. The aim is basically to keep it running smoothly and prevent any crashes (Per Christensson, 2020).

However, it was the primordial general task of smart technologies. Now they have gone way more further. Today we have smart technologies in everything, from watches to thermostats, smart homes and cities, and even smart toothbrushes. "Smart technologies are changing our life and our societies on a deeper level than ever before. Smart home assistants, vehicles, factories, banks, buildings and many more are highly interconnected, communicate with their environment and with us, and operate using various levels of artificial intelligence." – believed by experts from the University of Groningen, the Netherlands.

Objectives. Unfortunately, in Ukraine, we do not observe this level of developing and integration of technologies as other European countries. This leads us to the problem we would like to go deeper in. The level of urbanization shows how developed and safe for life the city is. It is recalled that the situation is foldable for modernization life support networks, which are critically important for big cities of Ukraine and especially for the capital.

Methods. As a solution, we can focus on a "Smart City" urbanization model. Smart Cities are focused on the ways that technology can improve municipal functions. Typically, this means involvement of automating street lights, using data to coordinate utility plans, technology-driven transport systems, and even specialized trash collection. It is a city model that uses digital and telecommunication technologies to create more efficient traditional networks and services, intending to enhance the welfare of residents and businesses.

Results. The Centre of Regional Science at the Vienna University of Technology defines 6 concepts that denote city as "smart" (Rudolf Giffinger, 2007). They are:

- "Smart Environment": Protection of the environment, attractive natural settings, low levels of pollution, and consistently sustainable management of resources and waste.
- "Smart Economy": a business-friendly city with an innovative spirit, flexible labour market and a solid economic reputation, in order to achieve more income and larger city budget.

- “Smart People”: improving the skills of citizens, giving high importance to learning, sensitivity to social and ethnic differences, encouraging creativity, cultural diversity and participation in public life.
- “Smart Governance”: Public self-government, that is participation in the decision-making process, ensuring the quality of state and social services and promoting government transparency.
- “Smart Living”: Investment in cultural and educational facilities such as museums, exhibitions, theatres, universities ect., optimal health and hygiene conditions, measures to ensure public safety, quality of housing, attractions to encourage tourists.
- “Smart Mobility”: A city that is physically accessible - on every level: locally and internationally and that utilizes sustainable, innovative, and secure data-transport systems for citizens.

Conclusion. Overall, it may be said that following these 6 concepts and the pursuit of a “Smart” model can be obtained the desired level of urbanization and development as well as the standard of living of citizens. In the future, these changes also may be useful for the environmental issues, mental and physical condition of citizens and the attractiveness of our country for foreign projects and investments.

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STREET ROBOTIC COURIERS

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Key words: robots, couriers, delivery

Introduction. The global economic effect of the new coronavirus pandemic cannot yet be predicted, while business losses in such areas as transport, tourism, entertainment, etc., are already measured in millions of dollars. However, some of the retailers can only benefit from the spread of COVID-19. Among them there are popular services for the delivery of ready-made food and groceries.

Objectives. The distant future associated with robotic parcel delivery has become a reality. When many people try to isolate themselves and socially distance themselves from the general public, delivery robots represent the ideal non-human delivery system.

Advances in robotics, GPS tracking, automation and navigation now mean you may not find a clerk at the door with your package any time soon. You can find a delivery robot instead.

Methods. Every year, the number of orders for a variety of goods through online stores is increasing significantly. At some point we will come to a situation where the current infrastructure and people will be unable to cope with this task. Already, many technology companies, including large online retailers (for example, the same Amazon) are beginning to realize the impending crisis and therefore are working on new, more advanced and high-tech ideas for delivering goods to their customers.

Several tech companies are developing and testing delivery robots for online stores and food delivery services in major cities. Development companies are already ready to form a new service market.

Recently, Marble's Scrappy robot appeared on the streets of San Francisco, which can automatically transport small-volume goods, such as small parcels, food, household chemicals, medicines, and the like. The robot is equipped with several cameras at once, which are able to record what is happening around and protect the cargo from vandals and robbers. A special mobile application allows you to open one of the compartments of the robot in order to get your package.

Renowned European home delivery firm Just Eat is planning to introduce delivery robots to its staff. The company is actively testing the development of the Estonian company Starship Technologies – a robot on wheels that looks like a lunar rover. The customer is informed in advance of the personal code of the lock, with which he can open the compartment lid and pick up food. The robot is completely autonomous, but remotely controlled by the operator. Of course, so far, the robot's capabilities are quite limited. For example, Starship can send an order up to 5 kilometers. However, due to the fact that the robot is able to bypass traffic jams and other obstacles, this distance is covered within 5-30 minutes.

Continental has its own vision of a solution to the coming problem. The main disadvantage of the previously proposed concepts with the use of courier robots is that they do not take into account the distance that the machines will have to cover in order to deliver the goods to the buyer. At the same time, these robots must be compact and maneuverable enough to actually deliver the order to the customer's door. Continental proposes to approach these issues with two components: a self-driving vehicle, the size of a small van, and a group of compact delivery robots. They will be transported together with the goods inside the unmanned vehicle, and then land near the desired delivery point and already deliver the ordered goods to the door. The company claims that the drone can be easily adapted to meet the specific needs of robot manufacturers. For example, in its concept Continental proposes the use of compact robotic dogs.

Results. It is difficult to underestimate the effectiveness of using ground-based courier robots. It is expected that this will lead to a decrease in the cost of delivery compared to the use of human couriers, which means that the cost of providing the service will decrease, which will serve as an additional incentive for the introduction of such devices. And finally, but not in terms of importance, the goods will be delivered to

the buyer faster! The losers will be people who worked as couriers – their demand will decline in the coming years.

Of course, it is also important to see how this robot will be perceived in the human community – nobody canceled theft and vandalism. Will attacks on robots become too frequent? Will buyers be ready to deal with them?

Difficulties in implementing courier robots:

1. There is no need for this kind of automation, there are many couriers;
2. No traffic rules for ground drones;
3. There are no procedures for resolving disputes when errors, shortages or damage to goods are detected;
4. dirt, puddles, snow and ice in winter;
5. vandals, thieves.

Conclusion. Thus, delivery robots can be useful for shops, restaurants, pharmacies and other service businesses. Companies can sell off-the-shelf robots to customers or provide a robotic delivery service instead of selling equipment. Major markets for such ground-based delivery robots are major cities and college campuses. The advantage of ground robots is their compactness, safety, ease of control and a relatively large delivery radius.

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OVERVIEW OF THE GLOBAL POSITIONING SYSTEM AND ITS FUTURE

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Key words: global, positioning, GPS, tracking, satellite

Introduction. The widespread usage of the GPS system by not only civilians, but also industries, has proven how vital and convenient it is to track many things on the planet within seconds through gadgets. Providing numerous uses, such as finding locations, surveying different places, managing transactions, or even as far as predicting natural disasters, it is of great importance for different businesses to improve this technology to provide even more accurate and precise tracking. The topic is especially relevant because of how dependent we have all become on this peculiar technology, which has greatly improved our lives.

Objectives. The main purpose is to conduct research for upgrading methods of global positioning system for accuracy improvement and avoiding any disruptions or intentional signal jamming that could lead to signal losses by providing more security.

Methods. The technology is based on a simple navigation principle of marker objects, which was used long before the advent of GPS. A marker object is a landmark whose coordinates are known exactly. To determine the coordinates of an object, you also need to know the distance from it to the marker object, then you can draw lines on the map towards the markers from the possible location: the intersection point of these lines will be the coordinates. GPS receivers are able to identify their location when three GPS satellites triangulate and measure the distance to the receiver and compare the measurements (Tracy, 2007).

One of the ways that comes to improving its efficiency is the usage of multiple satellites, in order to make the tracking spot-on. Such minor obstacles, like being indoors, having low battery and phone performance, or any other obstructions can cause instability in its veracity. A fourth satellite was released for calibration purposes, which have vastly improved GPS calculation of the coordinates.

It is important to note that it is the user's radio navigation receiver that processes these signals and computes the position fix. (Christopher, 2006). The use of radio navigation methods and means has made it possible to increase the accuracy of the passage of routes by moving objects and their output to a given area, as well as significantly increase the safety of ships and aircraft flights in difficult meteorological conditions, ensuring a greater precision for GPS systems while providing secure routes.

The fact that multiple satellites vastly improve the performance of GPS, a block of ten satellites are set to sail, known as "GPS III". Improving the signal frequency on it, and having the ability to catch signals from other global satellites, it will be much less prone to small mistakes and give opportunity to follow tiny distances for many areas, which will be of great benefit for different industries.

Results. With one of the GPS III satellites launched, the signal catching has become a much greater success, using modern technologies and advanced tools to pinpoint many spots on the planet. It was also provided with tougher resilience, preventing more sabotages and other outside damage which could disrupt the tracking process critically.

Conclusion. In the end, despite how rough it is to implement such new changes due to the fact that it involves space, our lives have tremendously improved thanks to the upgrades of an already life-saving GPS system. Aiding in tasks that requires our vision beyond our scope, the ability to scout an entire planet while watching it through a small smartphone screen has become a crucial quality of life addition, important to the point of needing to observe even smaller details. The development of such new satellites is critical for large companies, as they are greatly taken into account when it comes to efficiency at work, whether it be for tracking employees, or delivering, and small faults in GPS can cause many inconvenient issues, which are now being resolved thanks to modern technologies.

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MULTI-FACTOR AUTHENTICATION SYSTEM AS A METHOD OF DATA PROTECTION IN MODERN INFORMATION TECHNOLOGIES

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Key words: biometric identification, data protection, fingerprints, multi-factor authentication

Introduction. In our time and age, the development of information technologies is very fast. We use different devices in every sphere of life. One of the main problems is that most software can be hacked that cause financial damage to the manufacturer or users. That is why it is necessary to know how to save and protect your personal data with the help of the multi-factor authentication system.

Objectives. Multi-factor authentication is an authentication method that requires two or more independent ways to identify a user. Examples include codes generated from the user's smartphone, captcha tests, fingerprints, or facial recognition. Biometric human identification systems are becoming more common. This system is based on the uniqueness of biological characteristics that are difficult to falsify and which unambiguously define a specific person. To such characteristics we include the shape of the bosom, iris pattern, grid image eye nods.

Methods. Data protection in modern information technologies is a set of organizational, technical, and legal measures aimed at preventing damage to the information. Different scales and types of stored data require approaches to security, the use of different methods of authentication makes it difficult to develop a single data protection mechanism. Data protection practices maintain data integrity and confidentiality (Spasiteleva, Buryak, 2017).

Face recognition of a person by the image is divided among biometric systems; firstly, it does not require special equipment. Secondly, there is no physical contact between people and devices. You do not need to wait for the system response. In most cases, just walk past in front of the camera for a few seconds. Biometric authentication technologies are used by consumers, governments, and private corporations including airports, military bases, and national borders. We would like to recommend such method as password-based authentication, certificate-based, biometric, and token-based authentications.

Results. Keeping up with the basic methods of authentication for protecting your own technology will prevent access from the attacker.

Conclusion. To make a conclusion, we can just define that data protection in today's information technology is one of the most important issues. Its resolution is not easy but possible. There are many methods of protection that improve people's lives and

reduce problems. If you use a multi-factor authentication system, you will be definitely protected.

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METHODS OF NEURAL NETWORK TASKS ACCELERATION

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Key words: neural networks, acceleration, GPU

Introduction. The most common processing device, the CPU, is limited by its design. There is a limit to how small transistors can get. Therefore, effort is being put into developing specialized hardware such as AI accelerators or using existing technologies like GPGPU to accelerate neural network tasks.

Objectives. The main task is to research software and hardware solutions that can be used to accelerate neural network tasks.

Methods. Research existing technologies that are used to accelerate neural network tasks. Find the most recent solutions that have been proposed and found to be successful at enhancing the performance of neural networks.

Results. Most of the computations in neural networks are matrix addition. This includes the learning process and backpropagation. For smaller networks, this isn't a problem, but the more complex the network is – the more parameters there are. CPUs are applicable to complex tasks that need to be executed quickly.

The most common solution to accelerating neural network tasks is to use GPGPU technology. GPGPU stands for general-purpose computing on graphics processing units. In essence, GPUs are specialized processing units that are primarily used for graphics computing. GPUs are composed of many relatively weak cores, connected to each other. They are suited for running compute kernels specifically compiled for many concurrent small tasks, such as matrix addition. GPUs are traditionally more flexible and accessible with high-end models having similar architecture to those that are widely available to public. This has lead developers to create models that are optimized for GPU, for example AlexNet-R is 60 times faster on GPU compared to the high-end server-grade CPU. However, CPU is still a must, since it works as a task manager, saving intermediate results, launching new tasks when they arise.

Among others, Google developed an interesting solution to speed up neural network tasks. This solution is TPU. TPU is highly optimized for large batches, therefore it shows better results in more complex neural network models such as CNN. The latest high-end TPU models can be up to 10 times faster than high-end GPU models, tested on a Conv2d model. NVidia is now implementing tensor cores in their GPUs to accelerate neural network tasks on GPUs.

Another area of research, left relatively unexplored, is heterogeneous computing. Heterogeneous computing is a way of computing that involves using two architecturally different processing units working in parallel. The most common combination is CPU and GPU, more advanced or problem-specific machines utilize FPGA, TPU, Xeon Phi, and ASIC. CPU-GPU machines when working in parallel can experience a performance speedup in neural network tasks like normalization or weighing up to 4 times compared to CPU or GPU-only system. For such system to be effective there must be a task manager that can split the job between the CPU and the GPU in a way that would guarantee the lowest idle time for either processing unit.

Conclusion. Neural networks are a powerful tool and such tool needs a lot of processing potential. Time optimization for neural networks is crucial for them to be more widely available. Different methods have been researched to make neural networks learn faster, among which GPUs, TPUs and heterogeneous computing.

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INNOVATIVE TECHNOLOGIES IN SOCIAL SCIENCE

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Key words: technology, attractive, innovations

Introduction. Technology is moving incredibly fast. We admire our amazing era where fantastic things like autonomous cars, personalized medicine, and quantum computing are becoming real every day. Artificial Intelligence, crypto currencies, advanced automation, deep and machine learning, and concepts like Universal Basic Income are about to reshape our world!

Objectives. The primary goal of teaching innovative technologies in education encourages teachers and students to explore, research, and use all the tools to uncover something new. It involves a different way of looking at problems and solving them. It

aims at providing education with the help of innovative and attractive technologies, and program accessible to schools all over Europe.

Methods. World experience shows that with the help of social technologies it is possible to resolve timely social conflicts, relieve social tension, prevent catastrophes, block risky situations, make and implement optimal management decisions, etc.

Innovative social technologies are methods and techniques of innovative activity aimed at creating and materializing innovations in society, implementing innovations that lead to qualitative changes in various spheres of social life, to the rational use of the material and other resources in society. The result of the innovations introduction in the social sphere should be an improvement in the quality of life of the population in all regions, taking into account that different groups have their own needs.

Social innovations are diverse. This is primarily due to the variety of phenomena of social life. Sources of social innovation are changes in the environment, social problems that always arise, and which are impossible to solve using traditional methods as well as changing needs of the society and its members.

It is the presence of certain problems in the social sphere that gives impetus to the creation and development of new means and methods of social work. For example, this is how the helpline, which gives anonymous psychological help to people in stressful situations, was created. Another striking example is the creation of social services and social shelters.

Social innovations are innovations that affect large groups of people, usually of a non-profit nature and aimed at improving the quality of life of the population. Social innovation is an organized innovation in social practice in response to changes in social conditions, the needs of society, new problems that cannot be solved by traditional methods.

The specificity of social innovation is that the results appear after a certain amount of time and are often unpredictable. Distinctive features of social innovation are the presence of a close connection with specific social relations; dependence on the use of innovations on the group and personal qualities of users (clients of social services); lack of obvious advantages, in contrast to technical innovations.

Results. The main goal of innovation in the social sphere is to solve social problems in society. This is possible only if the efficiency of enterprises and organizations in the social sphere is increased, while the quality of social services is improved, taking into account the dynamics of the population changing needs.

The technological process requires constant improvement and innovation. However, innovations cannot be targeted, all fundamental changes must be comprehensive. For this, the technological task of social work is, first of all, in identifying a social problem, the nature of which will determine the definition of the content, tools, forms and methods of work.

Conclusion. The time we live in is a time of constant changes and the search for answers to newly emerging questions in the face of uncertainty in the world around us. Social technologies are a separate area of scientific knowledge and embody various forms of social self-organization.

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DARK FUTURE OF ARTIFICIAL INTELLIGENCE

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Key words: invention, electronic device, intelligence, smart home

Introduction. As the most intelligent creature yet known, humans, with all of their self awareness, tend to fear for their life. And it is not unreasonable to get anxious about your existence. Yet throughout history people had created a lot of deadly inventions. So you may be wondering what comes next. It is probably going to be artificial intelligence, and it definitely has potential to be the deadliest of all.

Objectives. Idea of "evil robots" wiping out human kind was mostly popularized by the film Terminator (1984), but it may be much scarier than that. Sure metal death machines are scary, but as H.P. Lovecraft once said "The oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown".

Methods. The Internet of things with super intelligence may be a silent, invisible killer. Imagine if every electronic device is connected to the internet, and tries to kill you: your smart home, car, fridge, etc. The other possible threat, which is more of a thought experiment is Rocco's Basilisk. It is said to be one of the most disturbing thought experiments ever, so be advised.

Results. Basically humanity will have created super intelligence which decided that those who didn't participate in its creation, but new about it possibly being created, are unworthy and will be tortured in simulation forever. So you have two options: start to invest your time and money into creating this super intelligence or hope that it will never happen. But the most disturbing part is with the number of people who know about it, probability of this A.I. being created us rising.

There are different solutions to this possible threat, the most elegant I think is Neuralink from Elon Musk. As he said on Lex Fridman podcast "If you can't beat them, join them". I won't go into details about how it will work but, the whole idea of upgrading your brain to A.I. levels seem kind of intuitive. The biggest bottleneck with data exchange through the internet is human "download rate" (how fast you can perceive information).

Conclusion. To sum up, according to Wikipedia human visual system can process from 10-12 images per second which is roughly 50 mb of data. And it is really slow even for current day computers. So if we surpass the limitation of our perceptive systems and transfer data directly into human brain, we will probably have more chances of survival.

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DATA SCIENCE IN CLIMATOLOGY

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Key words: statistics, modeling, climatology, data science

Introduction. The environmental processes taking place on our planet affect each of us. One of the key issues of climate science is to understand the trends of natural processes in order to predict certain environmental situations.

Objectives. The main task is to conduct research to describe and characterize the most popular and effective mathematical models designed to research environmental problems using modern information technology.

Methods. There are many models that can describe historical climate data, such as a regression model, decision trees, random forests, neural networks, and so on. It is most convenient to use Python programming language to perform mathematical modeling, because it is the most flexible for data analysis, contains a large number of built-in methods and libraries, which allows to quickly get good results. In addition, you can use R programming language, which is the second most popular for data analysis, and, for the time series analysis we can use the ready statistical package Eviews.

Results. Most often, ecological and climatic data are stored and studied in the form of large datasets or time series. Time series – a set of data of a particular process, recorded in chronological order at certain points in time. In order to describe a process, it is necessary to build a mathematical model. Each process has its own characteristics, so mathematical model must be built based on preliminary data analysis.

To build an adequate mathematical model for a time series, it is necessary to understand its structure. There are quite a number of tests for it. First of all, it is necessary to understand the number of single roots of the process (degree of stationarity). The Dickey-Fuller test is used for this purpose. To determine the linearity of the process it is necessary to use the BDS test. This information gives us an understanding of the correct structure of the mathematical model of the selected process.

If the input process is linear, an autoregressive model should be chosen to describe it. However, if the process is non-stationary, it is necessary to add a trend component of

one or another order to the composition of the model. In addition to the linear autoregressive model, there are many others that describe nonlinear trends. In particular, these are models with an exponential trend, hyperbolic, polynomial, etc.

It is also very important to study the variance of the process. It will allow us to respond in a timely manner to significant jumps that occur. For example, during the exploration of the average annual temperature of an area, we can predict when a significant temperature jump will occur. This will allow us to respond in time to certain challenges of nature. To perform modeling, we must first investigate the heteroskedasticity of the process. After that, a model of the heteroskedastic process is built. There are many variants of the structure of such models, for example, the autoregressive conditionally heteroskedastic model (ARCH), or the generalized autoregressive conditionally heteroskedastic (GARCH) or other.

Of course, during studying the process, we have to build a lot of models of different types, because it will allow us to choose the structure that best describes it. To compare models, scientists use special criteria for the adequacy of models, and to study the accuracy of forecasts they use special criteria for assessing the quality of forecasts. The most commonly used criteria are R squared, Akaike criteria, Durbin-Watson criteria. To compare the quality of forecasts the most popular are root mean square error (RMSE) and the Theil coefficient.

Conclusion. To sum up, modern mathematical models fairly accurately describe environmental and climatic processes. They are able to predict the significance of these climatic processes for the future, which will respond in a timely manner to climate change on the planet. However, each process requires its own research, a large number of experiments and comparisons.

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DEVELOPMENT OF ASSISTIVE DEVICE “ACOUSTIC SAFETY ANALYZER” FOR LISTENING TO MUSIC IN HEADPHONES ON THE STREET

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Key words: pedestrian safety, listening to music on headphones, artificial intelligence, device (ASA)

Introduction. Over the last decade, the number of injuries among adolescents when crossing the street or railway tracks has been increasing worldwide and in Ukraine. More and more young people are using headphones on the street, and almost every day there is information about injuries or even deaths of teenagers under the wheels of a car or when crossing the railway tracks while listening to music on headphones.

Objectives. The main task is to study the development of the device which helps pedestrians to avoid dangers and prevent injuries due to traffic incidents when listening to music on headphones.

Methods. Analytical – when searching for and getting acquainted with various approaches of injury prevention while listening to music in headphones; experimental – when researching the possibility of using various sensors to collect information and when selecting the optimal version of the principle of operation and components of the device, which should warn of danger; simulation – used to investigate the causes of dangers when listening to music on the street using a virtual environment, and developed a device for safe listening to music in headphones.

Results. A device has been developed to prevent injuries when listening to music on headphones while driving on the street and crossing railway tracks, the main function of which is to perceive, analyze and check for sound from an oncoming car or train and notify the user, while suspending other sounds (music) played by the user’s smartphone. In addition, there is an additional function of the device – it analyzes GPS data about the user’s location and notifies him when approaching the railway tracks or road, while pausing the sounds (music) that plays the user’s smartphone.

Conclusion. In the future, it is appropriate to adapt the device to the needs of people with disabilities, as well as optimize to the device in order to maximize its efficiency.

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LOAD BALANCING IN GRID SYSTEMS

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Key words. Load balancing, clusters, grid systems, distributed computing

Introduction. Every day new challenges arise before scientists, mathematics, and in our everyday life which require ever-growing amounts of computational power. And the progress in both wide area networks and parallel computing allowed for the development of distributed computing and in particular grid systems. It allows connecting multiple computing units such as servers or personal computers and uses their combined computational resources to solve tasks much quicker and at a lower cost. But in order to do that the available resources and tasks must be properly coordinated and distributed with maximum efficiency which is why a load balancer is used. Computational resources are not required to be uniform, they may have different capabilities and efficiency all of which must be taken into account by the load balancers.

Objectives. The load balancer is an algorithm that distributes tasks among available computing resources while trying to achieve the highest efficiency. The efficiency in this case besides solving each task in the shortest time possible includes minimizing idle resources and maximizing cost efficiency. Usually, a load balancer is a dedicated machine located between clients that provide tasks and computing resources that are a part of the grid system. But there are a lot of systems especially the ones with a very high number of computing nodes that have multiple load balancers. This introduces the need for synchronization of information and task distribution between them depending on network topology and hierarchy of the system.

Methods. Depending on the complexity of tasks, their nature, and flow load balancers can be typically split into two categories: static and dynamic. A dynamic load balancer distributes tasks when they are received while a static load balancer requires all of the tasks to be known ahead of time. Usually, a static load balancer provides more efficient solutions of load distribution but considering real-world applications tasks that require dynamic load balancers are much more prevalent.

Some grid systems make use of local load balancing where computing nodes are also taking part in load balancing. This makes the whole system more decentralized and therefore self-sustainable and failure-safe. In such systems, dedicated load balancers are only supplementary, and in some cases, can be removed entirely.

To distribute tasks between nodes load balancers must know computing nodes that they can distribute tasks to as well as their attributes such as the number of processing cores, their relative power, availability of GPUs or ASICs, network connection speed, and bandwidth. After that comes task evaluation where the time needed to complete the task on a reference machine will be estimated. Based on all those parameters, the algorithm will produce a graph that will be used to assign tasks to nodes for computing. Different algorithms prioritize different aspects of efficiency such as the highest throughput or lowest average time for tasks. Some systems make use of machine learning to adapt and make load balancing more efficient.

Results. As a result, there were developed a lot of approaches to load balancing each being used in different scenarios and to achieve particular goals. Grid systems give the ability to use computational resources that otherwise would be wasted. For example, having workstations do some work when a person went on a break gives the ability to share resources with someone who needs it. Grid systems and load balancers allow scaling that will fit any needs.

Conclusion. To sum up, grid systems can be used to share computing resources and provide distributed task computation. And load balancers are what enables ease of use and provides a lot of flexibility on how tasks will be distributed. There are a lot of approaches to load balancing each targeted for different needs. As the technologies continue to develop even more efficient load balancers will appear.

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AUGMENTED REALITY AS A PART OF EXTENDED REALITY

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Key words: extended reality, augmented reality, technology, devices, information, objects

Introduction. It is no surprise that IT technologies have recently been growing fast. And extended reality (XR) is only a drop to the ocean of technologies. It consists of Augmented reality (AR) and Mixed reality (MX). People believe that the term AR was first mentioned in 1990 by Tom Caudell describing digital displays that were used for building planes. Fitters who had portable computers with them, could see drawings and instructions via helmets with translucent display panels.

Objectives. The main task is to represent virtual subjects in the real world using special devices.

Methods. The common sense for creating extended reality is this way: AR camera takes a photo of a real object; software identifies the taken picture then chooses or calculates visual addition to it. The part of an object is digitized and then created a 3D model. This twin collects information about it, obtained from itself, from information systems and external sources. The augmented reality software scales and accurately places the actual data on or around the object image with its help. Furthermore, there are

several devices that are able to represent AR such as mobile devices, home devices that have display and special equipment.

Smartphones need to have a special software installed, for example City Lense for Windows phones or Wikitude – the browser with AR with ability to show nearest cafes, shops, sights etc. AR Glasses – a full device specially created for extended reality. They are able to project holograms and information into real space, but do not tie them to physical objects. Augmented reality lenses will be the technology of the future, unfortunately it's not developed yet, but Google and Samsung are working on it. Developers seek to transform lenses into a see-through screen containing LEDs, control system, antenna, small camera and other optoelectronic components.

For home devices that have display can be TV and computer display. Mostly, extended addition depicts yet on its displays. For instance, the names of streets and attractions are layed on the satellite image in Google Maps with Satellite mode.

Special equipment is, for example, military helmets. The important and necessary for the pilot information is displayed on the glass of the helmet, and he can perceive it without looking at the dashboard, thereby saving precious seconds.

Results. Appliances of XR can be found in different spheres. Dulux Visualizer and IKEA Katalog are a great helper when you want to do flat repairs. They can give you an opportunity to visualize what wallpaper color and with what exactly furniture would make your home look the best in your opinion. What is more, medical students also use AR-applications to learn organs in 3D mode as well as project them on their own bodies. However, those devices such as Google Glass, VR-helmets and etc. are not spread wide and extremely expensive, consequently not every person yet can afford it.

Conclusions. To sum up, extended reality is rather interesting and promising technology. In some years it will be developed, applied in every person's life and will improve all processes in 20%-40%.

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INTELLECTUAL SYSTEM FOR RECOGNITION OF MUSHROOM TYPES

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Key words: neural network, machine learning, intellectual system, morphological features

Introduction. Everyone knows that there is a problem of mushroom poisoning in Ukraine. The Ministry of Health of Ukraine reports that recently cases of mushroom poisoning have become more frequent, according to statistics in 2018, 174 people were poisoned, and 11 deaths were recorded. Analysis of cases of mushroom poisoning shows that most of them are caused by the use of lamellar poisonous mushrooms (primarily pale toadstool), which are mistaken for edible champignons. After researching the problems of mushroom poisoning and analysis of possible ways to reduce its level, we have the idea of creating an intelligent system that using a neural network can classify the types of mushrooms.

Objectives. The main task is to explore how neural network can solve problem of mushroom poisoning.

Methods. To achieve this goal, possible ways of mushroom recognition were analyzed.

Results. In everyday life we call mushrooms their fruiting bodies. Providing a biological classification of the mushrooms (ie the correct definition of the genus and species of mushrooms) requires attention to a wide range of features, many of which are noticeable in the usual examination of the fruiting body of the fungus, others are detected only after microscopic examination. So we can use a photo of mushroom for its classification.

The process of recognition is based on a neural network. It is a network of simple elements – neurons that receive input, change their internal state according to this input and produce output.

In essence, the neural network is a mathematical analogue of the brain that simulates the work of billions of neurons, but there are significant differences. Natural intelligence (ie man) is designed to solve universal problems, for example, not only to recognize what he sees, but also to decide what to do next. While artificial intelligence is specialized and its task is clearly limited: if it recognizes only mushrooms, the berries will be unknown to it. This specialization allows artificial intelligence to surpass natural intelligence in some specific tasks, for example, to classify tens of thousands of photographs in a shorter period of time than the same task would do a person. In order to achieve such specialized efficiency, the neural network needs to be taught specific skills.

Conclusion. The implementation of an intelligent system capable of recognizing types of mushrooms is a solution to a rather complex technical problem that requires in-depth knowledge of the subject area and analysis. It is based on a specially trained neural network. To do this, it is taught a large selection of different photos, each of which depicts a mushroom, about which everything is known in advance and reliably. Machine

learning is a very exciting topic that allows machines to learn to perform tasks that humans have historically needed. Thus, we can conclude that thanks to artificial neural networks can identify types of mushrooms, which can help many people not only save themselves from poisoning, but also learn a lot of interesting information about mushrooms.

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USER-FRIENDLY DECENTRALIZED APPLICATIONS BASED ON BLOCKCHAIN TECHNOLOGIES

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Key words: blockchain, decentralized application, user interface, chat bot

Introduction. Over tens of years the client-server architecture is dominant for networked applications. Accessing news, downloading documents (even this one), exchanging messages, committing financial transactions – all that is done using applications that implement this architecture. But such architecture has an important disadvantage – a single point of failure (Duchessi and Smith 1998). Mostly it is addressed to by deploying clusters, content delivery networks, multi-datacenter deployments, but still, the logic problem with the architecture remains.

On the other hand, decentralized environments, such as blockchain, cannot suffer from such problem by design (Aztori, 2017). In order to disable the network and make it inaccessible, all nodes of network must be shutdown. Deploying decentralized applications (DeApps) on such resilient network provides high level of accessibility and integrity that is guaranteed by the network design itself (Wei Cai, 2018). However, accessing those DeApps can be pretty complex task for average user that just wants to use it.

Objectives. The primary task is to research how is it possible to provide a friendly interface to average computer user, who does not want to deal with specific technical details of underlying blockchain technology.

Methods. I have analyzed common interaction methods with decentralized applications and their smart contracts. Having analyzed drawbacks of those methods I came out with a possible user interface solution that does not suffer from those problems. Moreover, I have assessed usability of the user interface and resilience of the way it is stored and accessed by the underlying system.

Results. Usually, using DeApps requires dealing with the DeApp smart contract directly or through some web page. Even considering the latter variant, where the user interface may be reasonably good and intuitive, serving web page or an application still requires a server, which possesses the centralization problem.

This problem can be resolved by storing the user interface logic as a smart contract itself. However, due to space constraints, this decentralized user interface (DeUI) should be reasonably simple and still easy and understandable for user. A great example of such interface is chat bot, which can provide information, ask and respond to questions, and provide simple select-a-button user interfaces. Stuffing a chat bot logic into a DeUI smart contract provides a friendly decentralized chat bot (DeCBot) user interface. A user can easily retrieve the logic of DeUI, or a DeCBot in particular, from the blockchain, and handle that logic to interact with the DeApp itself. Such mechanic allows user to just "talk" to the DeApp without learning how to interact with smart contracts directly, or rely on some web interface retrieved from some Internet server.

Usage of outlined method permits to provide a friendly and resilient user interface to a decentralized application. As the DeUI is stored in the blockchain, it does not suffer from centralization problems and is as accessible as the DeApp itself. By being a simple UI, such as a DeCBot, it does not consume much space on the blockchain, can be easily interacted by an average computer user and is, nevertheless, as arbitrarily powerful and flexible, as required by any specific DeApp.

Conclusion. While the blockchain technology with smart contracts is very resilient and flexible, the user interface is either not friendly, or suffers from centralization problems. The idea to store the user interface in blockchain itself solves the centralization problem. Meanwhile, using a chat bot as such user interface allows to create friendly and powerful at the same time interactions with user, permitting them to do everything that is required with the decentralized application just by chatting with a bot inside the blockchain.

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IMAGE PROCESSING IN MEDICAL FIELD

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Key words: image processing, medicine, neural networks, human body

Introduction. IT has gone through different aspects of our life and, in recent years, we have seen the impact of this technology in medicine. Image processing techniques are extremely important in understanding and collecting information from biomedical images. Neural networks are far-famed for excellent performance in functions, such as classification and approximation, that is why they have been successfully used in medical image processing for last years, especially in detection, preprocessing, recognition and segmentation (Naseera, Rajini, & Priyadarisini, 2017, October).

Objectives. Biomedical image processing is an immense and growing field. The modern world is evolving rapidly, so it is necessary to identify image processing methods, which are using now in the medical field.

Methods. The use of image processing techniques has played an enormous role in assisting surgeons and physicians in performing the operations on the patients and diagnosing the diseases. Medical devices have emerged due to a mix of image processing techniques and hardware, which has made a huge leap in the field of medicine. Digital image processing includes Image Acquisition, Image Enhancement, Correction/manipulation of color within an image, Edge detection, Smoothing of images, Image restoration, Conversion and construction of 3D images from 2D images, Artificial coloring to the images (Naseera, Rajini, & Priyadarisini, 2017, October).

Results. Obtaining biomedical signals, image processing (formation and display) for medical diagnosis based on derived features from the signal, images and video. Image processing has proved its importance in the medical field.

1. Radiography

Radiography uses electromagnetic radiation, mostly X-ray for viewing the human body of changing density and composition. Most often it is used for Dental Examination and Orthopedic evaluations.

2. Magnetic resonance imaging (MRI)

Magnetic resonance scanners generate significant medical images of the body using magnetic fields and radio waves. MRI is used to obtain and further monitor stages of the disease without irradiating human body.

3. Endoscopy

Endoscopy is used to inspect and examine the interior parts of an empty organ or pit of the body. It is commonly used for different pregnancy procedures, surgery like endoscopic, orthopedic and plastic. In addition, it is used in bomb disposal personnel.

4. Stereo Endoscope

Stereoscopic technology helps improve surgical accuracy and operational requirements. Stereoscopic imaging is applied in diabetic retinopathy, digital mammography, non-invasive surgical operations.

5. Computer Tomography (CT)

Computer tomography has become a vital aid in increasing X-rays and medical ultrasound. Usually, CT scans of the head are performed to identify and detect infarction, bone trauma, tumors, and hemorrhage. Furthermore, it is performed to detect changes in the inner lungs, such as acute and chronic, diagnose cardiac and abdominal diseases.

6. Electrocardiography (ECG)

Electrocardiography obtains information about the structure and functioning of the heartbeat. Some signs for ECG include suspicion of pulmonary embolism, seizures, fainting or collapse, atrial flutter, cardiac stress testing.

7. Medical ultrasound

Medical ultrasound is used to visualize the inner structures of the body. Ultrasonography performs diagnosis and therapeutic procedures with the aid of ultrasound to direct biopsies and drainage of fluid collections.

8. Positron Emission Tomography (PET)

PET monitors the metabolic processes in the body. Computer analysis creates three-dimensional images of the indicator inside the body. Figure 1 represents a PET scan image of the lung in which cancer can be easily predicted.

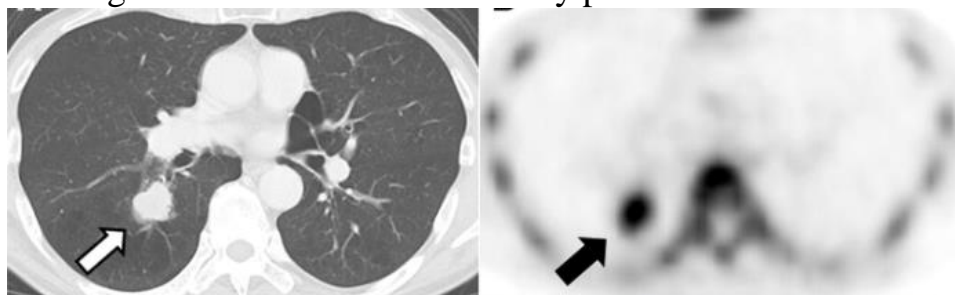


Fig.1 PET scan image of lung cancer

Conclusion. Imaging techniques play a significant role in obtaining signals and images from the human body which includes invasive and non-invasive methods. Ordinary image processing methods are integrated with neural networks and fuzzy logic. The interaction of the necessary integration of algorithms and the support of standard methods should open the way for doctors for future diagnosis.

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MACHINE LEARNING AS ONE OF THE LEADING AREAS OF THE XXI CENTURY

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Key words: machine learning, development perspective, our future

Introduction. The ability to automatically and quickly use mathematical calculations to a large amount of data is gaining momentum. According to the growth of demand and value, the demand for machine learning is increasing. Because machine learning forces computers to move to a new level of self-learning without explicit programming, that is, receiving new data, these computers learn, grow, change and evolve as information arrives. The relevance of the topic is the need for high-value predictions that can reflect the best solutions and therefore reasonable actions in real time without human intervention, ie machine learning is a subfield of artificial intelligence, and machine learning algorithms are used in other related fields (Kryzhevsky, Sutskever, Hinton, 2015, p. 55).

Objectives. Machine learning can be defined as simplifying certain tasks and increasing a certain degree of productivity when performing a certain task with the help of a certain type of learning experience. For example, as a definition of credit card fraud, the challenge is to appropriately name "fraud or non-fraud" any given credit card transaction. The appropriate performance metric that needs to be improved may be the accuracy of fraud detection, and credit card experience, according to which each is retrospectively marked as fraudulent or not. (Sue, Ba, Kiros, Cho, Curville, Salahutdinov, Zemel, Benjo, 2015).

Methods. The field of machine learning is quite young, but is expanding rapidly, respectively, is gaining more demand in various areas. The main trend of increasing demand for machine learning is the increasing globalization of modern information technology, and thus solving more and more complex problems and simplification, and therefore machine learning takes the form of complex software design that runs on large-scale parallel computing platforms and provides data analysts a number of algorithms and opportunities (Kryzhevsky, Sutskever, Hinton, 2015).

Results. Despite its practicality and future success, machine learning remains a young industry with many understudied scientific opportunities. Machine learning has great potential that needs to be considered and developed for the future.

Conclusion. According to these considerations, it can be assumed that machine learning is perhaps one of the most potential technologies of the 21st century, namely that society should now begin to consider how to maximize its benefits for the prospects of different directions.

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ARTIFICIAL INTELLIGENCE IN MEDICINE

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Key words: artificial intelligence, electronic brain, analysis, treatment

Introduction. The introduction of artificial intelligence (AI) systems in medicine is one of the most important modern trends in global healthcare. Artificial Intelligence technologies are radically changing the global healthcare system, enabling radical redesign of the medical diagnostic system, development of new drugs and overall improvement of the quality of healthcare services while reducing costs for both.

Objectives. Artificial Intelligence is the science and technology of creating intelligent machines, especially intelligent computer programs. AI is associated with the similar task of using computers to understand human intelligence, but is not necessarily limited to biologically reasonable methods.

Methods. Nowadays artificial Intelligence technologies are used in the fields of disease diagnosis, genome research, drug development and medical imaging. AI based devices can learn, analyze large amounts of information, and make decisions on their own. This saves time, money and serves patients' lives more effectively.

1. Analysis of human data and diagnostics

A complete medical history, data analysis for the whole period of treatment, the current state of the body can be collected and structured by the artificial intelligence system. The data uploaded to the database will not escape the attention of the electronic brain and will be processed quickly. It will save doctors time, increase the accuracy of diagnosis and allow you to prescribe the right treatment in a timely manner.

2. Medical visualization

Artificial Intelligence systems help automate routine processes in hospitals, speed them up and make them more efficient. This applies to the visualization of a variety of medical images such as ultrasound, CT, MRI. Studying these data and comparing them can take a lot of time with a doctor while AI can cope with the task several times faster than a person.

3. Creation and selection of medicines

Medicines are quite complex organic compounds and the search for the correct formula takes a lot of time. They require not only a careful approach to the development, but also numerous tests, checks, which also do not give a 100% guarantee that the drug will work. Artificial intelligence can come to the aid of developers who are able to quickly create the right chemical drug formulas. It will proceed from the given parameters.

Conclusion. Automating data collection in hospitals will facilitate the diagnosis of diseases, will be able to effectively predict and prevent diseases. Thus, artificial intelligence will not only facilitate the work of doctors, but also help to save more patients. In economic terms, the use of AI technologies is beneficial, as the costs in health care system will decrease, and the quality of medical services, on the contrary, will increase.

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ELECTRONIC HEALTH RECORD AS MAIN MEDICINE TOOL IN IT

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Key words: Electronic Health Record, clinics, medical history, encryption, healthcare

Introduction. An Electronic Health Record (EHR) is an electronic version of a patient's medical history, that is maintained by the provider over time, and may include all of the key administrative clinical data relevant to that person's care under a particular provider, including demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports (Electronic Health Records, 2013). The rising demand for optimization electronic healthcare systems in the healthcare information technology (IT) sphere is known to be a key factor having the market growing.

Objectives. Main task for EHR is to be integrated with a great variety of healthcare systems through internal interfaces. Nevertheless, system's complexity should make clinics and patients relationship management more easily to regulate. EHRs is a big step ahead in medicine that improves the relationship between patients and doctors. It provides clinicals with current patient information to make doctors see actual medical history and perform a better treatment.

Main benefits for patient are supposed to be:

- Clarification of medical records so that it can reduce the medical error and improve the accuracy of decision.
- EHR can help patient avoid extra or duplicate tests, so treatment process can begin earlier without delay.
- Increases patient satisfaction.
- Improved data management in clinics.

Methods. Web-based EHR is the most popular solution especially in 2016. The biggest disadvantage of this approach is that it requires a specific clinic customization. It contains setting a lot of solution based on doctors and patient's needs. The web systems are growing rapidly as they are more convenient for clinics, pharmacies, and small-scaled laboratories. What is dramatically important for these systems is security which means developing encryption to keep the data safe. Nevertheless, these cloud-

based systems offer attractive benefits without the need of infrastructure and maintenance (American Health Information Management Association. 2013). As to advantages to use this system you only need internet connected to your device. Subscription-based systems provide integrated operability convenient for small- to medium-scaled medical professionals. Another crucial solution is application to be downloaded on personal device. It is getting more popular and supposed to replace web-based solution.

Results. North America is considered to hold the largest market share nearly 42%. Developed countries will do great efforts to create such system for their healthcare sphere. Since it gives the opportunity to schedule appointments with physicians, apply for prescriptions.

At that time, Asia Pacific is the first on the line in the world to implement Electronic Health Record in all clinics as their economic is getting better, so government is sure that new healthcare information technologies can bring them to a new level. National well-being is always an issue to worry about.

Conclusion. As a conclusion it is worth mentioning such benefits of EHR as:

- Real-time access to complete patient records.
- Real-time notifications both for clinics and patients.
- Reduction in paperwork.
- Interface with labs.
- Improved coding and billing (Garrett, P., & Seidman, J., 2011).

It is no doubt that EHR can help with improving quality of people's lives to say nothing of life expectancy.

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INFORMATION SECURITY BASED ON BLOCKCHAIN TECHNOLOGY

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Key words: Blockchain, transaction, information security

Introduction. More and more industries are not keeping up with the rapid and continuous process of development and improvement of technological innovations. The

systems are unevenly developed, work according to outdated technologies and rules, so sometimes they are quite slow and unreliable. They are centralized and therefore constantly exposed to information leaks and hacker attacks.

Objective. Any information resource that contains confidential information requires the transmission of a security system. To the extent that, in an attempt to obtain available information, security threats are increasingly prohibited. Information security involves the use of all potential and real threats that may pose a school to the interests of the individual, society and the state.

Methods. Information security is the storage and protection of information, together with many systems and equipment, designed to use, encourage and transmit this information from unauthorized access, use, disclosure, distortion, alteration, research, editing or destruction. Ensuring information security includes a full range of measures to ensure the integrity and confidentiality of information about the conditions of its availability for users who have the appropriate rights.

Blockchain is a distributed database consisting of many blocks of information created in such a way that their unauthorized modification or removal is almost impossible. The information in the data blocks is protected by cryptographic methods. The main feature of the technology is that it is used to build systems with fixed digital registers, which are implemented in a distributed manner (without the use of centralized storage) and usually do not have centralized management. What added to blocks cannot be deleted and can be viewed by all participants in the Blockchain (private Blockchain) or by anyone (public Blockchain). This ensures that no changes to the Blockchain network can go unnoticed. Decentralization, consistency, transparency and the use of cryptography make this technology an excellent solution for information security.

Blockchain decentralization significantly reduces the likelihood of database falsification. The way hackers usually manage to obtain information is to attack the place where all the data is stored – the mainframe. In a blockchain, all information is distributed over the network and there is no single place to attack. Instead, hackers need to attack the information in each block separately, but each change is displayed to all participants in the blockchain.

Results. Blockchain can encrypt data, keep it confidential and secure, and guarantee the integrity of data from malicious attacks.

Conclusion. Today Blockchain technology, using all its advantages, can be an excellent method of information security and can be very useful technology in many areas of modern life.

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THE FUTURE OF INFORMATION TECHNOLOGIES

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Key words: intervention, robots, blockchain, cryptocurrency, data points

Introduction. Today we have a lot of opportunities that allow us to discover the world from a new perspective. The 21st century is replete with technological discoveries that can completely change our perception of ordinary things. Every day we see more than one example of the use of robots to perform a variety of work, ranging from small rooms to huge industries. And this is a huge advantage for each of us. And what changes should we be ready for?

Objectives. First of all is the development of artificial intelligence. According to experts, most companies will deploy artificial intelligence within the next 5 years. AI will become much more common and used than today. More and more mechanisms will be carried out without human intervention. This is especially true of heavy routine work.

Methods. All responsibility will be transferred to the robots. Everything a person has done in days, and sometimes even months, will be done in minutes. It is safe to say that AI will become an integral part of our lives. However, on the other hand, many industries will consider this a rather expensive prospect, and therefore will rather trust the old methods. Secondly is 3D printing. I am sure that 3D printing will be the biggest breakthrough in the near future.

Results. With this technology, you can do a lot of things today. Such as, small items, toys, accessories and even parts for aircraft. 3D printing greatly simplifies the production of items, and also makes the product much cheaper. Thirdly, blockchain. Blockchain technology is a digital technology used to record transactions. At the same time, it is safe due to its self-regulating nature. It's time to ask, what new trends can we expect from the blockchain? It is worth mentioning about LIBRA. This is a new technology that uses an open source blockchain that aims to revolutionize the world's economy by producing a cryptocurrency that is accessible to everyone. Blockchain will be directly related to the games that are available a huge part of the blockchain economy. It is planned that this technology will be used at the government level in the future. Using blockchain technology, they can exchange data as they circulate between infinite nodes. This makes data management more efficient. Innovations change every time, and definitely for the better. Summing up all that has been said, I want to add that AI plays a crucial role in modern history.

Conclusion. So how exactly do artificial intelligence process large amounts of data use a variety of algorithms and approaches? Having received the current data set, sophisticated artificial intelligence algorithms are able to detect any correlations or anomalies between data points. The answer to the question can be found in the data. And great success can only be achieved through hard work, so in any case, do not lose faith in yourself and keep moving forward.

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BREAKTHROUGH IN ARTIFICIAL INTELLIGENCE

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Key words: neural networks, artificial intelligence, technology, breakthrough

Introduction. Nowadays, technology is developing very quickly, especially in the field of artificial intelligence. It has been said many times what artificial intelligence will achieve in the future, but let's see what it has achieved at the moment.

Objectives. The main task of this study is to analyze the ability of the neural networks to improve our lives.

Methods. Analysis of existing new technologies of advanced companies.

Results. How can this technology be useful? For example, if you like audio books and the audio version of your favorite book does not exist yet, you can teach the neural network to read it with the right intonation. If you combine this with speech recognition technology and translation technology, you can communicate with a foreigner without knowing his language, because AI will translate and voice everything in a split second. You can also instantly receive a translation of the foreign videos, for example on YouTube. Perhaps in ten years, the accuracy of the translation will be better than that of good linguists and then there will be no need for this profession. A couple of years ago, Google announced that their artificial intelligence had learned to read lips better than any professional. 5000 records of the BBC program were analyzed by the neural network. As a result, the neural network learned to recognize the speech even when a person was swallowing parts of the words. And the developers are not going to stop

there, the potential for application development is huge: film anotizing, creating new methods of tracing criminals by special services, etc. Algorithms of neural networks involving computer vision allow the AI to self-learn and to explore the world. For self-driving cars this is extremely important, because you cannot pre-program all possible situations. Therefore, today manufacturers make unmanned vehicles travel thousands of kilometers, because the more the neural network learns, the more intelligent and less likely to make mistakes it is.

Conclusion. To sum up, just five years ago, if someone had heard about the current achievements of AI, they would have said that this is impossible. Now, this has already come to reality. Due to them, an absolute breakthrough in medicine takes place. One of the most striking examples is the recognition of diseases by inspecting retina. I have mentioned above only a small part of examples where the neural networks are used. According to the forecasts, a serious revolution is going to happen in this area. More precisely, it has already begun, but these are only flowers.

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DATA ANALYSIS: MODERN INFORMATION TECHNOLOGIES AND POPULAR PLATFORMS

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Key words: data, information, social media, algorithms

Introduction. Today we are living under the conditions of the information society, where information is a basic treasure in material, financial, economical, psychological, emotional, and other meanings. That's why it is interesting to discover those ways how the information is used by specialized companies which are successful in different spheres because of using the data.

Objectives. The main task is to discover how are companies dealing with modern information technologies and collecting data about their users. The main focus will be made on the overview of the Netflix as one of the popular mass broadcasting media platform.

Methods. In this research there were used the methods of formal logic, synthesis and analysis, comparative analysis, descriptive method.

Results. As data becomes the increasingly valuable resource, the ability to use this information can help to get fruitful results for those who can correctly collect, investigate and interpret the data. Nowadays we can find many companies whose policy is oriented not only on the provision of the services but on the collecting the data about their users. On the one hand, it is described as a tool to improve the quality of services, and that is true. But on the other hand, it is aimed on increasing the number of services which are additionally proposed for clients and every activity on their platform.

We can do it on the example of the well known all over the world company – Netflix. It is one of the media services providers, which evolved from subscription-based streaming service to a production company. Now they have a lot of different services.

This company now has a special department Netflix research, which is oriented on the study and investigation in such fields as machine learning, encoding and quality, experimentation and casual inference, computer vision and analytics (Netflix Research, 2020). One of the Netflix core products is recommendation algorithms, which provides personalized suggestions to Netflix's users. As it is explained on the official website of the company – it is created because of the desire to reduce the amount of time for search and to increase time for getting better content: “We do this by using the data about what content our members watch and enjoy along with how they interact with our service to get better at figuring out what the next great movie or TV show for them will be” (Recommendations, 2020).

The main focus is made on measuring long-term satisfaction metrics and dealing with the search, personalized ranking, image selection, page generation, messaging, etc. One of the main study areas in this field is the personalization of the search algorithms, improving of the interaction system-consumers, collecting metadata, incorporating more of a human element into Netflix search systems. This new strategy is discussed by the experts in the field and it is named as the most successful in the identifying what their audience wants (Dixon, 2019).

Netflix big data is based on 151 million of their subscribers which allows data analytics to discover customer behavior and buying patterns. So Netflix's recommendations of movies or TV shows to their users are based on subscribers' own preferences. Another way, which is used by Netflix to differ from the other media offerings, is based on *personalized visuals* (Chandrashekar, etc., 2017). As the group of authors of this concept describes in the Netflix Technology Blog, such an approach was build on the developing algorithms to handle cold-start by personalizing new images and new titles as quickly as possible, for example by using techniques from computer vision (Chandrashekar, etc., 2017).

The observer Michael Dixon underlines that Netflix collects user interaction data and pays a great attention to the response data. For example, Netflix knows the device used, the time and date when a user watched a show, whether the show was paused, the number of searches made by the customer and what is searched for, and so on (Dixon, 2019). This data allows Netflix to create a detailed profile on its users.

Conclusion. We can sum up with the statement that modern information technologies make it possible to collect the data and to deal with online and offline models of core metrics. All these require the involvement of data analytics. We have to

say that broadcasting platforms, as well as social media and other providers are making a rapid transition towards a more personalized experience for consumers, thanks to big data analysis. The amount of data that media and entertainment companies can gather regularly is definitely mind-blowing (Dixon, 2020).

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HIGHLY EFFICIENT WIRELESS ELECTRICITY TRANSMISSION TECHNOLOGY

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Keywords: wireless electricity transmission, magnetic resonance

Introduction. The world is changing. Electronic devices are flooding the market. Now we use wires to charge them. Agree, this is not the most convenient and reliable way. Wireless charging is the solution. A simple concept with incredible market potential. The global wireless charging market exceeded \$ 11 billion in 2019 and is set to grow by 14.5% annually from 2020 to 2026. Existing technologies are capable of transmitting power over a distance of several centimeters, reaching an efficiency of about 80%. But even a slight displacement of a receiver significantly reduces the efficiency. These systems cannot charge devices in motion. Moreover, they use high-frequency electromagnetic radiation. For this reason, there is currently no mass-market solution.

Objectives. The main task is to develop a technology for highly efficient wireless electricity transmission over a distance of several meters. Also conduct experiments to measure the effectiveness of the technology, consider possible use cases, analyze the results, and draw conclusions.

Methods. After analyzing existing technologies, we came to the conclusion that magnetic resonance induction is the most perspective. But existing solutions use flat coils, which also have several disadvantages. The main ones are only directional transmission and a few-centimeter transmission distance.

Developing the technology, we took into account all the shortcomings of our competitors. In our technology, we use strongly resonantly coupled hyperbolic coils to transmit power (Fig.1). Such coils and the resonance phenomenon significantly increase the transmission range and efficiency. The use of a different design of antennas and strong resonant coupling made it possible to achieve an energy transfer efficiency rate close to 1 at a distance of several meters. We also calculated that we can use low-frequency electromagnetic waves to transmit power. This will make the technology safer than analogs.



Figure 1. Frequency generator and hyperbolic coils

To confirm the effectiveness of the technology, we made antennas with a radius of 10 cm, connected them (Fig.2), and carried out the measurements.

Results. The experiment demonstrates superiority in range, efficiency, and safety over flat and cylindrical coils. Measurements showed that at a distance of 1.84m a frequency generator is loaded equally in the mode of wireless transmission to the load resistance and the mode of operation on the equivalent resistance (Fig.2). On both resistors, we measured a voltage of 100volts. Thus, as $R(\text{Load})=R(\text{Equivalent})=1000 \text{ Ohm}$, this indicates the equality of currents. The results indicate the equality of power: $P1 \approx P2 \approx 10W$. Thus, the efficiency ratio is close to 1.

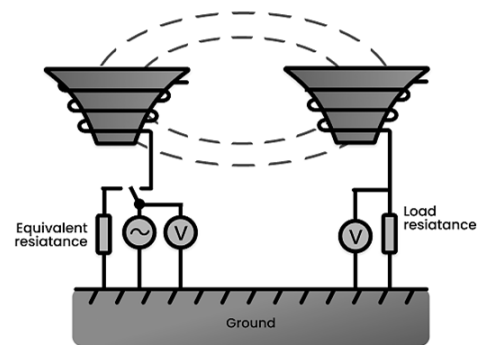


Figure 2. Coils Connection Diagram

Conclusion. The use of a different design of antennas and strong resonant coupling made it possible to achieve an energy transfer efficiency rate close to 1 at a distance of about 1.8 meters. And the use of low-frequency electromagnetic waves makes the technology safer than analogs. High amounts of power can be transmitted wirelessly. These factors distinguish the technology from competitors and create new value propositions for the user. In the future, we plan to reduce the thickness of the coils by half, increase the transmission power, and experiment with coils of different sizes, windings, and configurations.

So, the technology will make self-driving electric vehicles and robots completely independent, and automation of production and agricultural industry will increase their productivity. The wireless power potential can be used in medicine, smart homes, and cities as a part of the Internet of Things system. Scenarios of the wireless charging technology usage are limited only by the imagination of a manufacturer and the needs of the consumer. The technology can change the way we charge and use any appliance.

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CROSS-SITE SCRIPTING

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Key words: cross-site scripting, XSS, cyberattack

Introduction. Nowadays, cross-site scripting is considered one of the most popular types of attacks in the modern world. This attack also called XSS. To create an XSS attack, hackers use JavaScript language. Did you know that XSS is in the third place in the ranking of key risks of Web applications according to Open Web Application Security Project (OWASP)? Previously, programmers didn't pay due attention to this kind of attacks because they considered these attacks to be non-dangerous. This is a misconception.

Objectives. To study the problem of XSS attacks in the 21st century. To define ways to protect sites and confidential data from cross-site scripting.

The goal of an XSS attack can be not only hacking the site, but also the confidential data of its users, such as: addresses, telephones, e-mail, contact information, credit card numbers or access to payment systems.

The most important thing to understand about the areas of XSS attacks is that they can be passive and active.

Passive attack requires direct user intervention. This kind of attack is triggered when the user performs a certain action (click or mouse over).

Active XSS attack does not require any action by the user. A hacker creates a request using a combination of tags and symbols. Then the site analyzes the request and executes the command. As soon as hacker found a security hole, he can attach a "malicious code" to the request.

Methods. To check the site for xss vulnerabilities, you can use specialized services that will automatically scan the page. You can also check the pages in manual mode and exclude all dangerous special characters, replacing them with safe ones.

What about developers?

Firstly, the developer must use special filter to prevent the xss attack. Unfortunately, there are websites on the Internet that do not use any filters. If we want to protect the site from serious attacks, we need to build a more serious filter, because minimal filter protects the site only from amateur attacks. More detailed data filtering should take into account that the xss attack can come in the form of a nested construction.

The filter must also take into account all kinds of combinations of characters and the use of tags because a hacker can put additional characters inside the tag, which also needs to be filtered. It is also necessary to consider the possibility of encoding attacks. There are many encoder programs that encrypt an attack so that the filter cannot recognize it. Therefore, you must use some decryption algorithms in the filter before the program will execute the request code.

Results. Nowadays, most of the sites are well protected from this type of attack. But there is a percentage of sites that cannot withstand the attacks. This is a bug that needs to be fixed.

Conclusion. XSS vulnerability means that there are “holes” in the site code that could allow hackers to inject malicious code into your site. As a result, they will be able to set their ads or hidden links on the site

Protection against XSS attacks is a prerequisite for a successful project. Every year the punishment for disclosure, leakage and damage to personal data is increased. As a result, the owners monitor the security of their resources better. I hope that in the near future the problem of cross-site scripting will be eradicated.

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FAST DRUG CREATION USING AI IS AN UNREALISTIC TASK OR OUR FUTURE?

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Key words: AI, drugs, new medicine

Introduction. For centuries, people have tried to save their lives or improve their health. Scientific and technological progress in the second half of the XIX century allowed to synthesize many chemicals and create drugs. Nowadays, pharmaceutical activity is quite well-developed, but it takes years to develop medication. Now the problems are that people discover new diseases, new viruses appear, old ones mutate and a large amount of money needs to be spent annually to develop a cure for them. Also, often some compounds when combined can cause discomfort to people, affect their body and thus cause new problems. Therefore, drugs must be effective, safe, quickly invented and cost as little as possible. That's why people are starting to wonder if this process can be speeded up. Scientists claim that the use of artificial intelligence

can help in drug created, and if so, it may definitely become a revolution in pharmacology.

Objectives. Currently, science knows many different compounds suitable for combination, and which will be useful in medicine. Inventing the best combinations can take a very long time, but computer can do this much faster than human. AI can also reduce the amount of substances in drugs that we already know and make them cheaper by replacing other components. New research with using this technology can become groundbreaking.

Methods. Still the basic principle of development is the same as with human participation. The invented compounds will be verifying by scientists and will be allowed to be tested on humans only when meet the same requirements as any other medication (Lowe, 2020). Unlike human, AI can prioritise the most informative compounds for synthesis. Thus, the number of experiments during testing can significantly reduced. It is also possible that new compounds can be discovered in such a development.

Results. The British startup “Exscientia” use AI to create medication which meant to treat OCD (obsessive-compulsive disorder). It took only a year to invent the medicine, and this spring they began testing on humans. Exscientia’s CEO, Andrew Hopkins says that the compound that was developed – is DSP-1181. Expected that it will have a stronger efficacy than other existing drugs. The first phase of human trials will take place in Japan (Heiweil, 2020).

Conclusion. All in all, this technology can change a lot. Perhaps diseases that we considered incurable or pandemics such as coronavirus would not pose such a threat. This means that we will save our money, a lot of time and human lives. Many scientists think also that such invention of drugs is not worse as human-made. I hope that in the nearest future we will see new medicine developed with using AI on the shelves in pharmacies.

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LIDAR TECHNOLOGY

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Key words: LiDAR, light, technology, detection, measurement

Introduction. LiDAR is a technology that has been around for a while, emerging in many spheres at the same time. For example, it’s utilized for self-driving cars, robotics, drones as well as for augmented reality, when mapping out room measurements before putting 3D objects into that space. Apart from it, both iPhone 12 and iPad Pro

devices use this tech in a camera design to create greater depth in photos. But in the future there's a plan of creating AR glasses with embedded LiDAR sensors.

Objectives. The main task is to conduct research for how this technology works, paying great attention to its usage in smartphones and decide how it matters to the future.

Methods. LiDAR stands for light detection and ranging. As the name suggests, it uses lasers for measuring distance of the light pulse taken from detecting objects to returning to the source of the laser.

When some smartphones measure objects' depth with one light pulse, both new iPhone 12 and iPad Pro 2020 have an embedded camera sensor of LiDAR technology that sends infrared dot waves while measuring each one with its sensor and creating a field of points of objects' dimensions as well as the distance of separating two points.

Results. Using LiDAR technology instead of a standard single light pulse embedded in smartphones gives an opportunity to:

- better focus accuracy in camera. It gives an opportunity to take photos with enhanced focus and up to seven times quicker conditions. In addition, LiDAR is stronger in low-light shooting effects, allowing it to improve night portrait mode too.

- enhanced augmented reality. As a matter of fact, some AR applications use LiDAR technology to build a quick 3D map of a room with many additional details such as putting virtual objects into the room space mappings like on a chair, for example.

- adapted autofocus. So there's bad news and good news when it comes to both the iPhone 12 Pro and iPad 2020 Pro's cameras. The bad news is that, for classical photography, you get a similar sensor and image quality to an older device like iPhone 8, for example. It's not a bad shooter, but it can't match iPhone 11 Pro. The good news is that the LiDAR sensor could be used in some really interesting cases of night shooting with special 3D scanner canvas.

Conclusion. To sum up, LiDAR technology has already been used in many cases starting from 3D object recognition systems for self-driving cars all the way down to drones, robotics and room spaces for augmented reality. These lasers are also embedded in the iPhone 12 Pro and iPad Pro 2020 cameras with enhanced picture and focus quality. There are also apps, built under LiDAR technology, that allow us to test out this technology right away. One of them is the "Measure" app, where you can measure everything from large objects to a person's height and receive accurate results.

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AN IMPACT OF INFORMATION TECHNOLOGIES ON UKRAINIAN INTERNET BANKING

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Key words: information technology, internet-banking, electronic banking, banking services

Introduction. Nowadays information technologies are successfully integrated and are developing in almost all spheres our lives. It is not surprising that such sphere as banking also practice modern information technology in their systems and online banking systems have started to gain popularity on the market.

Objectives. The main task is to conduct research which innovations are used by banks to improve their services and analyze which influence has internet banking on usage banking services in Ukraine.

Methods. Research and comparative general analysis was used as a method of research.

Results. Internet banking is an electronic payment system that enables customers of a financial institution to conduct financial transactions on a website operated by the institution, such as a retail bank, virtual bank, credit union or building society. For the first time the Internet began to be used in the provision of banking service in the 80s of the XX century (Sadaf Firdous, 2017). Online banking is the type of "home banking" – technology, which allows the client to carry out certain operations without leaving home. The composition of "home banking" includes:

- Telephone banking;
- PC banking;
- Internet banking.

The last one is the most effective and popular, as it does not require a special personal computer, which can be used to connect to the bank's servers, and a phone with specially installed programs for work, but only an Internet connection.

The most of all banking services user can carry out at home via application or web-browser, without physical presence in bank. And both users and bank employees has benefit from this type of activity.

The cost of one transaction costs the bank in the amount of 0 UAH to 35 UAH (Prostobank, 2020). Moreover, the cost of implementing an online service can be compared with the cost of creating one branch, a branch of the bank. But, given the cost of maintaining an Internet office, in contrast to the physical, it is easy to notice that that online banking will pay off many times faster. Also, it is important to notice that user can use online application or browser everywhere, so demand of internet banking is increasing. Moreover, in such epidemiological situation 57% of consumers prefer internet banking (World Retail Banking Report, 2020).

Another reason for creating online branches is competition with other banks. Today, the availability of electronic banking system is a significant advantage for its owner.

The list of services that can be obtained through the use of Internet banking in Ukraine is now quite wide and tends to grow. Ukrainian banks offer their customers the use of Internet banking to view account statements. Most of them also offer payment services. Some banks offer customers to use internet banking for currency exchange, deposit, replenishment and withdrawal of funds from a savings account, replenishment of a mobile phone, payment Internet service provider, payment when buying tickets and provide others services. The most relevant products in remote channels are: payment utilities, deposit placement, card management, connection / disconnection of GSM-banking. The volumes of use are growing card-to-card (P2P) instant money transfer services available use not only from the bank's website, but also through mobile banking (Holiuk. & Drapaniuk, 2018).

Despite the significant advantages, there are already disadvantages that slow down the introduction of Internet banking in Ukraine. First, it is lack of permanent internet connection in many settlements. Though, now there is a growing trend of the share of the population that enjoys worldwide network, but this share is still significantly smaller compared with the share of people using the Internet in developed countries. Second, it is the population's doubts about the level of security of financial transactions via the Internet. After all, cases of fraud with the use internet occur quite often.

Conclusion. To sum up, the main reasons for the introduction of electronic banking are ease of use, minimization of the cost of their maintenance, compared with the maintenance of the bank branch, and competition in the market. Internet banking in Ukraine is a promising area development of banking services. Scale the use of Internet banking in Ukraine has recently increased, but all still remain insignificant in comparison with developed European one's countries.

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VECTOR TECHNOLOGY FOR PROCESSING GRAPHIC INFORMATION

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Keywords: Vector graphic, vector image, vector technology

Introduction: Almost from the moment, the computer was created, computer graphics have appeared, which is now considered an integral part of world technology. In the beginning, it was just vector graphics – building an image using so-called “vectors” – functions that allow you to calculate the position of a point on a screen or paper. For example, a function whose graph is a circle, straight line, or other more complex curves.

A collection of such “vectors” is a vector image.

Objectives. With the development of computer technology and technology, there are many ways to build graphical objects. But first, let's define the term “graphic object”. It is either the graphic itself or a part of it. Depending on the types of computer graphics, this term refers to both pixels or sprites (in raster graphics) and vector objects such as a circle, square, line, curve, etc. (in vector graphics).

The basic logical element of vector graphics is a geometric object. Simple geometric shapes (the so-called primitives – rectangle, circle, ellipse, line), compound shapes or shapes built from primitives, color fills, including gradients are accepted as objects.

The advantage of vector graphics is that the shape, color, and spatial position of its constituent objects can be described using mathematical formulas.

The important object of vector graphics is the spline. A spline is a curve through which a particular geometric figure is described. Modern TrueType and PostScript fonts are built on splines.

Vector graphics objects are easily transformed and modified, which has almost no effect on image quality. Scaling, rotation, the curvature can be reduced to a couple of elementary transformations over vectors.

Methods. An important advantage of vector graphics programs is the developed means of integrating images and text, a single approach to them. Therefore, vector graphics programs are indispensable in the field of design, technical drawing, for drawing, graphic and decoration work.

However, on the other hand, vector graphics may seem overly rigid, “plywood”. It is really limited in purely pictorial means: it is almost impossible to create photorealistic images in vector graphics programs.

And besides, the vector principle of image description does not allow automating the input of graphic information, as a scanner does for a bitmap.

Results. Vector representation consists in describing image elements with mathematical curves, indicating their colours and occupancy (remember, a circle and a circle are different shapes). A red ellipse on a white background will be described by

just two mathematical formulas – a rectangle and an ellipse of the corresponding colours, sizes and locations. Obviously, such a description will take much less space than in the first case. Another advantage is high-quality scaling in any direction. An increase or decrease in objects is performed by increasing or decreasing the corresponding coefficients in mathematical formulas. Unfortunately, vector format becomes unprofitable when transferring images with a lot of shades or small details (for example, photographs). After all, each smallest glare, in this case, will not be represented by a set of single-coloured dots, but by a complex mathematical formula or a set of graphic primitives, each of which is a formula. This makes the file heavier. In addition, converting an image from a raster to a vector format (for example, using Adobe Strime Line or Corel OCR-TRACE) leads to the inheritance of the latter in the impossibility of correct scaling up. The increase in linear dimensions does not increase the number of details or shades per unit area. This limitation is imposed by the resolution of input devices (scanners, digital cameras, etc.)

Conclusion. Having dealt with the concept of vector graphics and analyzed it, we can say that this technology is useful in its use, although it has some disadvantages. Many illustrative graphics packages are now available that contain easy-to-use, sophisticated and powerful vector graphics tools for both print preparation and web page creation.

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THE NECESSITY OF STUDYING STREAM AND BLOCK CODES

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Key words: eSTREAM, NESSIE, SNOW 2.0, Stream codes, Block codes

Introduction. Modern issues of choice, application, and practical implementation of stream-encryption algorithms are becoming more and more important, because, after all, symmetric stream ciphers play an important role in information security, for which stability and speed are important requirements. An effective solution to privacy problems in satellite and cellular networks is possible only with the use of streaming encryption. Stream ciphers are also widely used in networking technology. Recently, streaming encryption schemes have become widely used in commercial products and are no longer "proprietary technology" for special use. However, using stream ciphers, like any other cryptographic technology, requires accuracy and precision. Due to well-known shortcomings in the GSM standard, the A5 stream cipher is used.

Objectives. Software-oriented stream ciphers should provide a sufficient level of stability, speed, and be compact in the hardware implementation. A shift register is one of the elements used in the construction of hardware codes; therefore, they require constant inquiry and analysis. In addition, the search for a resistant synchronous stream cipher is of considerable interest in the European scientific community. This indicates the presence of projects eSTREAM and NESSIE, aimed at finding sustainable stream ciphers. Currently, scientists are working to create a national standard in streaming-encryption in Ukraine.

Extensive usage of streaming-encryption schemes makes the actual problem for their cryptanalysis. Many scientists who assess the stability of the cryptographic algorithm are researching this issue. We can define a cryptographically persistent cipher as a cipher, which cannot be decrypted (broken) in real-time. To do this, scientists perform some attacks on the study code, study its properties, weaknesses, and try to improve it.

Methods. All methods of cryptanalysis of stream ciphers are typically divided into three classes:

1. Power method. It deals with the attack by exhaustive search (brute all possible). The complexity of an exhaustive search depends on the number of possible solutions to the problem (the size of the space keys or plaintext space). This type of attack is applicable to all types of streaming-encryption. Developers strive to make this type of attack the most effective versus other existing methods of hacking during the development of encryption systems.

2. Statistical method. It is divided into two subclasses:

– The method of cryptanalysis statistical properties of the encryption gamma. It is aimed at studying the original sequence cryptosystem; the cryptanalyst tries to set the next bit sequence with a probability, which is higher than the probability of random selection using different statistical tests.

– The method of cryptanalysis complexity sequence. Cryptanalyst tries to find a way to generate a sequence of similar gamma but in a more easily implemented way.

Both methods use the principle of linear complexity.

3. Analytical method is the type of attack. It is considered under the assumption that the cryptanalyst knows the description of the generator, opened, and closed texts. The task of the cryptanalyst is to determine the key used (initial filling registers).

Types of analytical attacks applying to synchronous stream ciphers are:

- correlation;
- compromise “time-memory”;
- inversion;
- “provides for and defines”;
- the key loading and re-initialization;
- XSL-attack.

Results. One of the works that have been studied by us is the work of “Generalized statistical attack on stream ciphers” by A. Oleksychuk, S. Konyushok, and A. Storozhuk. It describes the statistical attack on synchronous stream ciphers (the

signs generated by the key gamma do not depend on an open and encrypted text and depend only on the source of the secret encryption key) based on algebraically degenerate approximations of Boolean functions and the probabilistic approximation method of searching this function. The efficiency and complexity of this attack were conducted on the example of GRAIN-128 and, furthermore, the ability of using this cipher was analyzed.

Conclusion. Thus, we can conclude that the contemplation of stream ciphers and cryptographic methods to analyze them are extremely important in today's world because streaming-encryption is used everywhere thanks to its speed. Nowadays, the stream cipher SNOW 2.0 is being the basis of Ukraine's standard in streaming-encryption. We know that this code is cryptographically resistant to attacks based on statistical algebraically degenerated function but it needs further research concerning other attacks.

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ALGORITHMS AND MACHINE LEARNING FOR DYNAMIC PRICING

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Key words: pricing, artificial intelligence, supply and demand, cannibalization, marginality

Introduction. The traditional method of pricing was to hire experts to somehow systematize the pricing policy of a company. There were two possible approaches: premium pricing and penetration pricing. Premium pricing implies high prices such as retailers differentiate from other competitors by selling unique and high-quality products. Penetration pricing approach implies setting prices lower than other retailers on the market. Either premium or penetration pricing is not effective in practice. They are highly vulnerable to human mistakes and target only limited groups of customers.

Nowadays, many retailers use dynamic pricing algorithms that provide a stable strategy for product pricing and increasing customer base.

The main task of dynamic pricing is often related to price discrimination. Referring to different researches dynamic pricing is an attempt of a seller to force a customer to pay the highest price he is ready to spend. Dynamic prices have affected many modern technologies and sectors of industry such as pharmacy, information technologies, telecommunication, high fixed costs and less marginal costs. The dynamic pricing main concept is straightforward. It used to quickly adapt to changes based on data about supply, historical data, customer demands (Kaunas, 2012, p. 217).

Objectives. In this paper we will try to prove that the new concept of dynamic pricing strategy by using artificial intelligence technology can be more accurate in calculation and prediction of the product price that customers will be willing to spend on it.

Methods. The data is collected based on customer preferences and information such as the kind of product that customer wants to purchase, the user location, the amount of time spent on the products by the user (Michaellyam, 2019, p.1).

The dynamic pricing algorithms based on these steps:

1. Analysing historical data of price changes on a particular product.
2. Building the demand function based on identified within the previous step dependencies.
3. This formula is then extended by adding a range of pricing or non-pricing factors. These factors can be inventory costs, competitor prices, promo activities, procurement expenses or demand cannibalization between particular products on market.

4. After the large data set of related information is analyzed the optimal product price is generated.

5. This recommended price is further analyzed using these automated rules to take into consideration the latest changes in market or customer demands.

The accuracy of the results depends on the data that will be processed. To generate more precise results, the data must be diverse.

Results. The greatest advantage of dynamic pricing is that it is more quick and effortless than other historical methods for product pricing. It accommodates more quickly with the classical economic model of supply and demand.

A different agile model of product pricing can be set for different customers. This algorithmic model is already used by ride-hailing startups Uber and E-commerce giant Amazon. This model can also be adapted to physical stores. For example, Kaufland, a supermarket group in Germany, has already adopted digital labeling technology in thousands of stores (Zhou, 2018, p. 1).

This approach has also some disadvantages. The previous algorithm strongly depends on data that will be analyzed. The difficulties may be with brand-new products that do not have enough information to generate accurate function. It can cause significant financial risks. Another disadvantage of this technology is the lack of uniform dynamic pricing definition, the variety of dynamic pricing determinants and indicators, the lack of DP models applicability in practice, simulation of the only one determinants group (supply or demand side) (Deksnytė, 2014, p. 70).

Conclusion. To sum up, an algorithm based automated process of dynamic pricing with artificial intelligence can cause substantial changes in many industries and boot up business. Of course, it requires some efforts and money investments. But switching to an algorithmic approach of product price generation and choosing the right dynamic pricing engine will have significant results and profit in the future.

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USE OF COMPLEX NETWORKS IN DESCRIBING AN INFRASTRUCTURE OF THE GLOBAL NETWORK

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Keywords: internet, Global Network, Complex Networks

Introduction. Nowadays, there are a lot of systems in our everyday life that unintentionally got a complicated structure. Such things as Global Network, relationships between partners in a large group and similar to it structures are unavailable to be depicted using most of the current methods. There is a rather freshly discovered theory which is being highly investigated up to this day, which is very convenient to use in such situations. It's called a Theory of Complex Networks.

Objectives. The main task lies in using said theory and methods to successfully describe an infrastructure of the Global Network, which would allow for better understanding of some complicated processes happening in the network, such as the spreading of the computer virus in the network (and the possibilities of its prevention), or the popularity gain, talking about some viral content, etc.

Methods. The Complex Network itself imagined as a graph with a limited amount of knots, and a large number of connections between them (Yevin, 2010). Specifically talking about our model of the Global Network, knots are being websites in the network, and the connection between them is referring to hyperlinks on one webpage to the other. All of the knots and connections are given their certain coefficients, also known as weights, which can show different measurements for each webpage and connection (such as the speed of the server, for example). This way we can successfully make a model of the internet as a Complex Network, allowing ourselves to use already developed methods of finding certain values or susceptibilities in the web.

Results. The result of such interpretation with a given structure is tremendous. It gives the possibilities of describing such a chaotic structure as the Global Network is. This model can be used to research some issues with the webpages on the internet and troubleshoot them globally, by calculating and keeping in mind the possible impact on the entirety of the network.

Conclusion. The theory of Complex Networks allows for a proper and convenient way of modelling and understanding a Global Network, the thing that is being used every day in our lives and nonstop gets even more knots and connections to work with. It is an extremely powerful mathematical apparatus that can be applied to some other advanced

structures, such as the spreading of the biological viruses, the neural architecture of the human brain (Chialvo, 2008), the grids in crystal and alike materials, and so on.

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MACHINE LEARNING IN CYBERSECURITY

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Keywords: Artificial Intelligence (AI), IoT, cybersecurity

Introduction. Machine learning (ML) is used in information security to protect data from leaks, unauthorized access, abuse of user privileges, virus attacks, and other cybersecurity threats. What’s more, criminals use ML.

Objectives. Machine learning (ML) can be used as a target when an attacker replaces datasets or manipulates models and algorithms to make the wrong decision. That is, attackers do not attack personal data, some automated systems, or critical infrastructure, but directly machine learning, so that the system makes the wrong decision. ML is sometimes used as a tool by hackers.

This topic is quite popular today and is best known in the context of deep fakes, when various personalities, similar to real ones, are created and laid out either for fun or for something else on the Internet. There are many ways in which attackers infect devices for their own benefit. In particular, machine learning technology is being used by cybercriminals to improve malware and make threats more difficult to detect. A famous example is Emotet Trojan, which uses machine learning to improve the identification of infection targets.

Today, our lives are increasingly intertwined with the digital sphere, and in this regard, new risks appear. Attackers can use machine learning in a variety of ways: manage malware, target specific victims and steal their identity, look for zero-day vulnerabilities, or control an infected network.

Methods. The most common methods of using machine learning for malicious purposes are:

- Creation of new malicious programs with improved automation of infection;
- Increased attack speed to steal confidential data;
- Search for new zero-day vulnerabilities;
- Creation of malicious bots that help to collect information about a specific organization in the shortest possible time;
- Infection of IoT devices, as they are an ideal platform for the accumulation of confidential information about the user;

– Carrying out phishing attacks with bots that can create professional emails to mislead the victim. An example is a request for an account with minor changes to the name and logo of a legitimate company.

Results. The traditional approach is starting to fail today. If earlier, a few years ago, we could divide good and bad in a 45/45 ratio, and only 10% remained for incomprehensible activities taking place in the infrastructure, today the situation has changed: 10% is clearly harmful, 20-25% is clearly normal. In addition, the remaining 60-65% are unknown. Moreover, for this undefined action, we begin to apply machine learning.

Conclusion. To ensure the proper level of security, threat recognition and response should take a minimum of time. Technological progress allows us to create security systems that are constantly learning, evolving, adapting, and looking for new ways to prevent previously unknown types of attacks. This is what constitutes a major breakthrough: their ability to prevent cyberattacks.

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USAGE OF CONVOLUTIONAL NEURAL NETWORKS TO CURE HUMAN DISEASES

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Key words: machine learning, medicine

Introduction. Since ancient times humanity was fighting diseases. With a human evolution, diseases also became highly developed and difficult to cure. That was the reason for a humanity to create new and new methodologies for illnesses treatment.

Objectives. The main task is to conduct research for using machine learning methods for detecting different illnesses. The topic will go about convolutional neural networks (CNN) in particular which presumes basic knowledge of machine learning methodologies.

Methods. Firstly, let's figure out what is CNN and how does it work. CNNs mostly work with photos and is used for the classification problem. As in most cases of machine learning, its structure has 3 layers: input, hidden and output ones. We will go about hidden layer in more detail. Because CNN has photos as an input the work will be done with pixels. There is a Convolutional layer called Kernel which "discovers" the photo by going through it with a fixed stride to establish some connection between neighbour pixels. In fact, what it does is the extraction of the high-level features. There is also used a layer called "Pooling" which decreases computational power required to

process such an amount of data. Also it is used for extracting dominant features. For example, a CNN called AlexNet had 60 million parameters to train. It's impressive.

Results. So, how can we use CNNs to help people? For example, let's take pneumonia – very insidious and dangerous illness. If we have a great dataset of fluorographies of human lungs labelled with 1 or 0 which means has a human on the particular image pneumonia or not correspondingly, we could train our own neural network to determine almost instantly if a human needs treatment or not. In fact, many enthusiasts have already built such networks for breast cancer detection and pneumonia either: results are more than satisfying! Such a technology can drastically reduce that invaluable time needed to decide if the treatment is needed, especially in case of cancer diseases. Obviously, neural network can not fully replace doctors and medical tests but they can become a helping hand for doctors in cases of human fatigue or inattention, etc.

Conclusion. To sum up, in close future machine learning will greatly influence on our lives making it more safe and comfortable. The horizons for this technology are not seen and unlikely to be seen in the next 20 years because of the number of fields where it can be used. It seems that soon we will not be able to imagine our world without neural networks and that is unbelievable.

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AUDITING UNIX SYSTEMS

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Key words: Unix system, auditing programs, super-user

Introduction. Security auditing programs are extremely useful tools for the administration of a system since they allow to detect in a routine way security problems for which there could be known attacks. A security auditing program should be able to detect them without compromising the integrity of the system.

Objectives. Auditing the syslogs of Unix systems can provide important information about events on your network. This information will help you decide on various administrative and security actions, that is to detect that a system is vulnerable to a DoS (Denial of Service) attack leaving the system “hanging”.

Method. These programs can operate at many levels from checking the membership of files to system users and groups to testing installed applications to see if they have known holes, for example:

1. Complete Unix log management and auditing.
2. Monitor Unix processes, user activity, mail servers, and more.

3. Checking the permissions of files, directories and devices.
4. Two-level password cracker which has actually been done using the notorious Crack.
5. checking the content, format and security of the password files and group ge.

Results. Unix systems auditing gives you full control over the security and management of your network and the correlation function provides a customizable rules device to alert you when specific events occur in sequence. Records are securely archived and easily searchable with the flexible product registration forensic feature. And not only that, we could also add plugins that add extra capabilities to the program, although some are for the Enterprise version.

Conclusion. The primary purpose of Audit Programs is to analyze the system to try to find ways to obtain super-user privileges. Its design is based on the hypothesis that any other uid (User identifier) or gid (Group identifier) can be obtained by unauthorized persons that is that any person can impersonate any user of the machine except of course as the super-user.

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IMPLEMENTATION OF MODERN CRYPTOGRAPHIC ALGORITHMS ON PROGRAMMED LOGICAL MATRIXES

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Key words: programmable logic matrix, hardware implementation, software implementation, cryptographic algorithm

Introduction. The process of cryptographic data conversion can be carried out both in software and hardware. Hardware implementation is used to protect telephone conversations, send faxes, and other types of information transmission, where it is impossible to use software, has better speed characteristics, and greater security.

Objectives. The main task is to conduct research for the implementation of modern cryptographic algorithms on programmed logical matrixes (PLM) that will not only be rapidly rotting but also be safe for humans and the environment. The use of PLM greatly facilitates the process of replacing ICs of small and medium levels of integration in the implementation of arbitrary logic functions.

Methods. Programmable logic matrixes, which belong to the methods of accelerating the operation of implemented encryption algorithms, have become widely used in various embodiments of cryptographic information protection equipment. Most cryptographic PLM operations are faster than regular programs. The more fixed

parameters there are in the algorithm, the more efficient the device will work. Examples of fixed parameters for cryptographic operations can be keys, final and initial fields, various coefficients. The speed is due to the large number of logical elements and automatic parallelization of the algorithms used.

Such schemes are in demand due to the speed and ability to replace quickly a compromised or outdated encryption algorithm. Combining the flexibility of programmable methods and the power of hardware to implement modern cryptographic algorithms on PLM is an urgent task (Petrov, 2008).

Results. The greatest success in achieving this goal has been achieved in the field of flexographic printing. This direction is relevant today, as the speed of information transfer is constantly increasing, and the need for its encryption remains, encryption systems implemented software using processors or microprocessors often do not cope with such a load.

Conclusion. To sum up, we can state that research and the search for implementation of modern cryptographic algorithms on programmed logical matrixes is a leading theme. This question is being addressed in the field of cryptographic algorithms. Thus, the direction of further research will be the analysis of the possibility of implementing modern cryptographic algorithms on programmable logic matrices.

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PROSPECTS OF USING 5G COMMUNICATION TO IMPROVE MUNICIPAL VIDEO SURVEILLANCE SYSTEMS

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Key words: 5G protocol, secure communication, IoT, video surveillance

Introduction. In the modern world, there is a transition from an industrial to an information society through the active implementation of digitalization policies. This is because people's needs for the amount and quality of information are increasing. In addition, more and more devices are connected to the world wide Web, forming a machine-to-machine messaging environment – the Internet of Things (IoT). However, not many modern communication protocols can offer the viral flexibility to build complex systems for collecting and processing information. The issue of real-time video monitoring at airports and urban areas is especially acute.

Objectives. To consider the advantages of 5G communication for the implementation of a secure and high-speed channel for the exchange of video streams. To provide recommendations for the video surveillance systems developers.

Methods. Anticipating the trends in the development of machine-to-machine interaction, in 2015, the special agency of the United Nations ITU-R started working on a fifth generation of wireless mobile communication.

In order to meet the growing needs of users and ensure proper QoS (Quality of Service), high requirements were initially set, including: an increase in data transfer speed by 10-100 times (up to 10 Gb/s) and an increase in the number of devices connected to one base station by 10-100 times (up to 300 thousand per node). Also, protocol allows to reach an increase in battery capacity, prolongation of autonomous operation of sensors for devices, and reduction of network latency to 1 ms.

Due to the different requirements for the communication protocol being developed, ITU divided the possible 5G services into three sectors. Enhanced Mobile Broadband (eMBB) focuses on the digitalization of human life. This is a standard designed to improve the speed of interaction with virtual and augmented reality, as well as the exchange of an HD video stream. Ultra-reliable and Low-latency Communications (uRLLC) strives to meet the demand for low latency between messages: this is important for the autopilot and medical industry. Massive Machine Type Communications (mMTC) fulfills the task of increasing the density of devices per gateway: this covers the needs of a smart city and agriculture (5G Network Architecture, 2016).

From the point of view of the technology of encoding data into a signal, the approach in the 5G protocol is fundamentally different from the 4G. For a high modulation rate of the signal, MIMO signals are used: this allows for a higher data transfer rate in the allocated hertz of the bandwidth (the bit/hertz value increases). Such an increase is achieved by a better spectral signal efficiency at the same energy expenditure. Moreover, this additional advantage can be used in various ways: it is possible to increase either the coverage area, thereby increasing the quality of signals in the network, or the autonomy of the device.

Results. Thus, the new standard, in comparison with previous generations, provides greater flexibility in tuning, increased transmission speed, spectral efficiency and, as a result, reduced maintenance costs and reduced energy consumption, which is important for autonomous systems of mass use. New opportunities can be used to create highly autonomous video surveillance systems with wireless data transmission in the 5G standard.

5G technology combined with edge (or “fog”) computing can significantly improve city or an airport control through video surveillance. We recommend using microprocessors for processing the frames received from cameras. This will allow receiving “useful” data directly to the operator's server, and relieve him of responsibility for filtering out unnecessary information. In addition, video preprocessing assumes its compression: in combination with 5G, this opens up prospects for a larger number of connected cameras. The capacity of city surveillance cameras is limited, and the bandwidth is insufficient to transmit a large number of recordings at the current time. Because of this, video analytics is usually only used for forensic purposes. Limitations in latency and reliability also prevent video surveillance from being fully implemented for security purposes. However, the increase in edge computing resources with 5G will

enable video analytics to be performed on multiple incidents. Lower latency and secure communication channels using the network segment will be important when transmitting critical data in real time.

According to analysts from Gartner, the number of points of connection of surveillance cameras to 5G networks will grow to 2.5 million in 2020, in 2021 it will be 6.2 million, and in 2022 – 11.2 million, respectively, and only in 2023 year the share of connected video cameras will give way to autonomous cars (Gartner Survey, 2018). Thus, over the next three years, CCTV cameras deployed by city operators to secure buildings and detect intrusion will constitute the largest addressable market, as they are located outdoors in many different cities and require a constant connection to the cellular network. That is why we recommend developers to pay attention to such areas as the development of 5G transmitters, the construction of high-speed video surveillance systems and the development of solutions for the integration of existing systems.

Conclusion. The trends in the transition of world society to a new generation of communication create new challenges for developers. The flexibility and benefits of 5G standard provide new opportunities for developers in the field of retraining video surveillance systems. Future research is planned in the field of physical and technical protection of 5G gateways.

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BIOMETRIC PERSONALITY IDENTIFICATION SYSTEM BY HANDWRITTEN TEXT

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Key words: Identification, signature, recognition, biometric system, handwriting

Introduction. The proposed method of personal identification by handwriting is based on multi-projection methods of image analysis, which allows to increase the accuracy and reliability of identification.

Objectives. Describe the method of personal identification by handwriting is based on multi-projection methods of image analysis, which allows to increase the accuracy and reliability of identification

Methods. With the development of new technologies, the problem of information security is becoming increasingly important. Given the variety of potential

threats to information, the complexity of its structure and functions, as well as human participation in the technological process of processing and storing information, confidentiality can only be achieved by creating a comprehensive protection of information. And one of the main elements of such a security system is a subsystem that provides computer user identification. Biometric characteristics are an integral part of a person and therefore cannot be forgotten, lost or passed on to others.

Results. Today there are two major classes of biometric systems for identifying users of information systems – static and dynamic. The first class of methods is used to develop biometric systems that analyze static, unchanging personality characteristics. The second class includes biometric methods that analyze the dynamic, behavioral characteristics of the person.

Signature - one of the classic methods of identification, used for centuries in legal practice, banking and trade.

Conclusion. The method of biometric identification of the person by the form of the handwritten signature is investigated in the work. For this purpose, the technology of parallel shift and Radon transformation is used. The image of the signature is analyzed from several sides by analyzing its projection and the planes of intersection of the shifted copies and the originals in several directions. This approach increases the accuracy of identification, and can also be used for various forms and scales of images of signatures and handwritten text.

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DO WE REALLY NEED BILLION-SCALE DATASETS FOR AI?

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Key words: Artificial intelligence, computer vision, artificial neural networks, supervised learning

Introduction. Modern AI-based algorithms proved their superior performance over humans on various tasks and benchmarks starting from image reasoning to driving a car or even helping with depression, but, just 10 years ago, such complex cognitive tasks were unbreakable for any automation algorithm. So, what did change in such short notice? There are two core reasons - increased by several orders of magnitude computational power of modern hardware of our PCs and wide availability of big amounts of data which gathered into datasets for specific tasks. Optimal size of a dataset varies from task to task. The most “data-hungry” algorithms are Computer Vision algorithms which analyze visual information like photos and videos and must capture

huge diversity in objects which can be shot from different view-points, at different lighting conditions, at different scale and size, or can be simply occluded by other objects on the scene.

Objectives. Modern Computer Vision datasets include from 80.000 to 14.000.000 images on top of which already build thousands of great applications with good performance, so do we need to spend billions of dollars on collecting bigger datasets or we can limit ourselves to already existing ones?

Methods. To verify this hypothesis Facebook AI Research team concluded a fascinating experiment based on top of Instagram photos and hashtags that users left for these images. The idea is the following: what if instead of spending tens of years collecting a billion-scale dataset we simply reuse hashtags from Instagram images, that describe what is depicted on these images and provided by users, as our noisy true labels for these images and train a neural network to predict these hashtags. After several months of data preprocessing, which includes merging duplicated hashtags into one “meta-hashtag” and removing duplicated images, the team collected the biggest dataset in the world which consists of 3.500.000.000 images related to 17.000 unique hashtags and pre-trained ResNeXt-101-32x16d deep neural network using classical supervised approaches for artificial neural networks on these images. After that, they finetune this model on previously existing datasets to perform specific tasks and benchmarked it against existing ones.

Results. Model pre-trained on Instagram hashtags outperform all existing approaches that trained on smaller datasets by a large margin – from 5% to 15% depending on task and dataset (Mahajan et al., 2018).

Conclusion. This small experiment of the Facebook AI Research team showed researches all-over the world that modern AI-based algorithms benefit from training on enormous-scale datasets, even if they have extreme noise in their labels like hashtags, and we need not only concentrate on improving algorithms on existing datasets but also create new approaches for collecting bigger datasets in much cheaper ways to make them available not only for billion-budget corporations but also for small business that tries to do our lives much easier, safer and enjoyable.

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MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE FOR BIODIVERSITY

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Key words: artificial intelligence, machine learning, ecology, ecosystem management, environment

Introduction. Our world is in chaos and this is entirely driven by human greed. The rapid disappearance of flora and fauna is one of the most serious environmental

problems. But chaos is the fuel to innovation. We have to manage the conflict between economics, human society and the biosphere. To change something into positive way you have to understand and see it clearly. Biosphere is a complicated dynamic system that we are trying to control. The key for this can be Artificial Intelligence and Machine Learning. They can play a positive role in saving our planet from our very own hands.

Objectives. To describe new technologies that can help with ecosystem management.

Methods. Having sensors and cameras placed all around the ecosystem, it is complicated to use collected data because of its enormous amount. ML and AI can provide a wide variety of algorithms and methods of processing and use of data collected from the biosphere.

The advantage of ML over traditional statistical techniques, especially in earth science and ecology, is the ability to model highly dimensional and non-linear data with complex interactions and missing values.

ML can speed up the pace of science by quickly performing complex classification tasks normally performed by a human. What took the expert 100 hours was brought down to less than 20 by the AI. The expert only needs to review enough data to train and test an algorithm. That will help to make habitat modeling and species distribution faster. Which is very important to take the necessary steps to preserve the species and also visualize the state of each individual species in dynamics, especially in the face of climate change.

Results. In the case of ecosystem protection and safety, AI can spot, count and predict the movement of endangered species in real time. Using drones filled with night-vision cameras and guided by AI, it is easy to track quickly and spot poachers. We can replicate this practise around the world at scale.

Similarly, the AI and ML algorithms can be used in various areas of ecosystem management: forecasting, climate change studies, natural resource management, species control, and others.

Proper implementation of ML methods requires an understanding of the data science and the discipline that can best be achieved through interdisciplinary collaboration. But also the important part of encouraging adoption of innovative ways is to reduce the cost of ML and AI techniques.

Conclusion. To sum up, Machine Learning and Artificial Intelligence are the change agents which transforming the chaos around biodiversity into order. This method helps to improve researches and modeling in the sphere of ecology and have a clear sense of the health of every animal species so that timely actions before danger strikes can be taken.

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ANALYSIS OF PROTECTED LMS REQUIREMENTS FOR THE SECURITY AND DEFENSE SECTOR

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Key words: LMS, data protection, DBMS, hashing, authentication, IP address

Introduction. Recent events have proven the need to create an effective secure distance learning system. Every year, information leaks are becoming more widespread, terabytes of personal data are in the hands of attackers. Accounts with simple passwords often suffer from hackers. To protect any type of information and control access to it, it is necessary to authenticate the user. According to the Law of Ukraine "On Information Protection in Information and Telecommunications Systems", the secure state of processed information is determined by three main properties – its confidentiality, accessibility, and integrity.

Objectives. To improve the protection of the learning process management system, it is advisable to use the AES standard, which makes the information inaccessible to an attacker who has bypassed possible password authentication. You should also use hashing the user's access password to the LMS database, encrypting the information in the database. It is also advisable to use database access roles. The hashing stage aims are to ensure that the hash value must be unique to the unique data set, so there is no need to keep the password clean – its hash value is sufficient.

Methods. This approach involves the following steps:

1) At the first authorization to create a new account, the user writes his data in the database.

2) The database records user data, while the user password is recorded in a locked form. With unauthorized access, an attacker will not be able to obtain a ready-made password to connect to secure DBMS departments.

3) When logging into the database, the user enters his data, and the database searches for an entry with the name and hash value of the password, which will be compared with the user's password entered during authorization. If this process is performed correctly, the DBMS provides the user with access to information in accordance with the granted privileges.

Also, to strengthen the security of the database itself, the corresponding hash function can be used to hash attributes of tables or even table names, which can be attached to specific user data as well as to other data required by the program. This approach involves the widespread use of cryptography to ensure data protection and

software protection to protect the database itself, which will reduce the performance of data processing but will increase the level of data protection.

Regarding information protection on the network level, the majority of attacks are connected with the IP protocol, IP-substitution of node address, imposition of false route, malicious range interception of IP-address and obtaining information about the logical structure of the network (IP-address knots, domain names), problems of one-time identification by IP-address. The following steps are required to protect data against these attacks:

- creation of IP-MAC port bindings to prevent IP address substitution and unauthorized connection to the network;
- use of technology of network addresses broadcasting for hiding from external malefactors of the organization IP-addresses range and logical structure of the network;
- creation of access control lists to restrict access to nodes and protocols / services of the application layer.

Any traffic that does not meet the broadcast criteria passes between other interfaces on the router, is never transmitted and forwarded using the router.

Results. Traditionally, two approaches are considered when analyzing security tools: the use of proxy servers and the use of session control mechanisms. These approaches control connection. For protection, content filtering is used, which provides for the analysis of data in the package. This allows to establish correspondence between the information from the data field and specific applications, to control the transfer of data between programs and to filter out unwanted material.

Conclusion. Comprehensive implementation of the developed recommendations will ensure a given level of information security of the LMS distance learning system. And this, in turn, will allow to fully realize the advantages of the model of “lifelong learning” in the system of training specialists in the security and defense sector.

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RISK MANAGEMENT IN INTERNATIONAL DEVELOPMENT PROJECTS

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Key words: risks, development, project management

Introduction. Project management in the modern sense was born when businesses and non-profit organizations began to realize the advantages of the project organization and network planning of their activities. At the same time, approaches to dealing with risks that accompany projects always and everywhere have also been developed.

Objectives. To describe the risks that could be faced during development for international projects and to discuss ways of dealing with those risks.

Methods. Risk can be defined as an uncertain event or condition that can have either a positive or negative impact on project objectives. Risks are classified into the variety of categories: significant risks, neglected, critical, acceptable, unique, single, static, dynamic, predictable, natural, anthropogenic, economic, etc. Let us take a closer look at the following two categories: negative risks (also known as threats) and positive risks (opportunities). So, negative risk is a risk that can lead to a worsening of the situation (increase testing time, increase the cost of work, reduce quality), positive - on the contrary, improve the product. Threat response strategies include escalation, avoiding, transfer, mitigation, accepting. Risk Mitigation is a risk response strategy in which the project team acts to reduce the likelihood of occurrence or impact of risk. It involves reducing the impact of the adverse risk to acceptable threshold levels. Examples of risk mitigation actions include implementing fewer complex processes, running more tests, or choosing a more reliable supplier.

Results. Many problems arise from the desynchronization of the project time. If the project is international, it is necessary to carefully consider holidays and non-working days in all countries participating in the project when planning the delivery and the resource calendar. Indicating the time in client time zones can help to avoid misunderstanding and potential risks during discussing dates and scheduling meetings with teams from other locations. Cultural risks – another one big group of risks that can be faced in international projects. In such projects, it is recommended to spend more time communicating to choose words as clear and unambiguous as possible. Also, the difference in mentalities significantly affects working communications, and it must be considered. Following the mentioned recommendations, managers can avoid multiple risks or reduce their impact on the project.

Conclusion. The project manager must fully understand the nature of the project to be able to deal with a variety of possible risks. The paper covers some of the risks that may arise in projects distributed in different countries and/or different time zones and recommendations for their mitigation. Avoiding risks helps to work effectively and efficiently and implement the project with minimal losses.

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