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*Матеріали  
X Регіональної науково-практичної конференції  
молодих науковців та студентів*

## **СУЧАСНІ НАУКОВО-ТЕХНІЧНІ ДОСЛІДЖЕННЯ У КОНТЕКСТІ МОВНОГО ПРОСТОРУ**

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У збірнику надруковано наукові праці X Регіональної науково-практичної конференції молодих науковців та студентів «Сучасні науково-технічні дослідження у контексті мовного простору» (англійською мовою) з природничих, гуманітарних, соціально-економічних, інженерно-технічних аспектів та новітніх інформаційних технологій. Для студентів, аспірантів, викладачів закладів вищої освіти та науковців. За зміст статті відповідальність несе автор.

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# **Секція 1**

***Сучасні дослідження в сфері  
природничих наук***

## **ANALYSIS AND STRUCTURE THE OUTER MEMBRANE OF GRAM-NEGATIVE BACTERIA**

In contrast to Gram-positive bacteria, the cell wall of Gram-negative bacteria includes an additional component – outer membrane (OM), connected by lipoprotein to the peptidoglycan layer.

Starting from the outside and proceeding inward the first layer encountered is the OM (1). OM is an exceptional feature of Gram-negative bacteria. This structure includes proteins, phospholipids, lipopolysaccharides (LPSs) and separates the periplasmic space (PS) from the environment. Although OM is not involved in the constructive metabolism and biosynthesis of organic compounds, it is a multifunctional organelle [1, p. 240].

As for the structure, the outer layer of the OM is composed of an unusual lipid - lipopolysaccharide, rather than the usual glycerophospholipid, found in most other biological membranes [2]. LPS molecules consist of three main parts: hydrophobic lipid-A (a conservative structure that is almost identical in many Gram-negative bacteria), central oligosaccharide (area, which may contain a certain amount of sugar residues and phosphate groups) and O-antigen (modified sugar units, the sequence and junction type of which, results in a huge variety of O-antigens in different strains Gram-negative bacteria) (3).

In addition, OM contains so-called outer membrane proteins (OMPs) that cover up to 50% of its surface [1, p. 250]. Different protein

structures are used in functionally defined processes such as transport of substances, primary reception of information from the environment, etc. In general terms, the OMPs are split into major and minor. In terms of functions, OMPs are divided into three groups: lipoproteins – bind the outer membrane to the peptidoglycan, integral proteins – perform a structural function (stabilization of the cell shell), integral proteins – perform a transport function (porins).

An interesting component of the OM are membrane vesicles (MVs). These are spherical bubbles (blebs) 15-400 nm in diameter [1, p. 255] (2, 4). MVs are highly versatile in their functionality and play an important role in interaction of bacteria with environmental elements. Despite the similarity of composition (due to the synthesis involving this components) MV with OM and PS, MV still has some differences in its own protein structure and additional functionality, that allows to argue the involvement of MV data in the secretion of certain proteins and the specific transport of those (6).

Bayer junction (BJ) – it is a transportation system that's barely mentioned in various sources. BJ is a transport channel of 20-30 nm width and wall thickness of 17-19 nm, thanks to which the OM and PM are connected [1, p. 257]. The functional role of these channels is the supposed intermembrane transport of certain components (such as glycerophospholipids) to OM (5). However, there is a further question: is this pattern permanent or only occurring during transport/secretion? Different researchers have their own views on this, where in the first case, the permanence of BJ is due to the most likely mechanism of structural interaction between OM and PM [1, p. 147], and in the second, temporal formation of BJ with the participation of certain cell

components or external influences.

As a result, it is essential to note the importance of OM as a structure, whose purpose in the cell wall is really unique. In general, in addition to basic functions such as protection, OM is also involved in selective transport of molecules, specific surface interactions with other microorganisms. Providing a truly formidable barrier to PM, OM is a highly problematic structure in terms of successful antibiotic therapy and the use of drugs to eliminate Gram-negative bacteria. This in turn can provide comprehensive antibiotic protection (primarily against  $\beta$ -lactam antibiotics) which consists of two main parts: barrier function OM (reducing the effect of antibiotics and other antibacterial agents due to narrow pores and the presence of a hydrophilic domain in LPSs) and modification variability of protein or lipid composition (because  $\beta$ -lactams use transport porins and macrolides use lipid layer). Based on the above, the study of the resistance mechanisms and the OM of Gram-negative bacteria is in my opinion, an important and necessary task today.

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## **HABITS THAT DISRUPT THE QUALITY OF SLEEPING**

After a sleepless night, we do not always feel comfortable: we think badly, we are distracted all the time, we have passive behavior and the like. It is enough to miss only 1.5 hours to lose attention by a third. But spending 7 – 8 hours in bed does not mean sleeping. Due to broken sleep phases, frequent awakenings or snoring, we can feel broken, even if there was enough time. Such disorders are often blamed on gadgets, caffeine, alcohol and exercise shortly before bedtime. We found out what scientists think about it.

How do gadgets affect sleep?

Experts conducted an experiment in which subjects were asked to spend five evenings in front of a computer and the same number evenings reading books, newspapers and other printed materials. The study involved men and women aged 22 to 28 years. According to the results, the use of light-emitting gadgets, such as a computer, phone or tablet, has a negative effect on the speed of falling asleep. This is due to the fact that blue light falls on us from the screens, which suppresses the production of melatonin in the body – a hormone that helps to fall asleep [1].

Can coffee really disturb sleep?

As a rule, for a good rest it is advised to exclude coffee in the afternoon. And this advice did not arise out of nowhere. In one experiment, the total duration of sleep was reduced, although



participants took it as long as 6 hours before going to bed. In another study, 200 mg of caffeine at 7 am so encouraged the subjects that even after 16 hours they slept less and worse than usual. But not everything is so clear. The effects of caffeine on sleep depend on many factors, including: genetic preconditions; features of the environment; reaction to stress; the presence of bad habits [2].

Can exercise reduce sleep quality?

In general, training helps you fall asleep faster, sleep longer and better. Physical activity protects against insomnia: the more exercise, the less often it happens. Any training has a positive effect: aerobic, strength, frequent and rare, intense and not very. After activity, people of any age sleep better: teenagers, adults, the elderly. Training time also does not matter much. Scientific work on this topic shows that evening exercises do not interfere with night rest. On the contrary - after activity people spend a little more time in a deep sleep, than without physical exercises. The only exception is high-intensity exercise. Daily maximum exercise reduces the quality of sleep and physical capabilities of the body [3].

How does alcohol affect sleep?

The effects of alcohol depend on how much you drink. Alcohol can have a calming effect and speed up falling asleep, but the quality of sleep decreases rapidly for several reasons: the phase of fast sleep is suppressed; the total duration of rest decreases; the load on the heart increases; suppressed breathing in sleep; decreases the production of growth hormone [4].

Summarizing the above, we can conclude that alcohol has a bad effect on sleeping, coffee can prevent you from sleeping if you

are sensitive to caffeine and prone to stress, and blue light from the screens of gadgets spoils the quality of falling asleep. But training will only benefit you, even if you exercise 30 minutes before bedtime.

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## **TRICODERMA AS A PRODUCER OF CELLULOLYTIC ENZYMES IN BIOTECHNOLOGICAL PRODUCTION**

In recent years, due to the rapid development of biotechnology, interest in microscopic fungi of the genus *Trichoderma* has increased that attract researchers with their practical value in obtaining enzymes, biologically active substances, toxins and antibiotics [2, p. 36]. Scientists pay special attention to devising biological products, since most of these saprophytes have high antagonistic potential, growth rate and the possibility of cultivation in industrial conditions.

The main producers of industrial enzyme preparations are fungal cultures, including *Trichoderma* species that are capable of producing such enzymes as cellulase, chitinase, pectinase, xylanase, serine-dependent proteinase, etc. Enzyme complexes based on *Trichoderma* strains are used in many biotechnological processes. For example, the enzymes produced by the fungus *Trichoderma* are successfully applied in the textile and food industries, in alcohol production, in making wine and juice, in producing olive oil, in wood, pulp and paper industries, in the production of detergents, feed additives and biofungicides [1, p. 4]. The ability of fungi to grow on various substrates and even on synthetic polymers, together with capacity to destroy cellulose, is employed for disposal and transformation of waste, biological treatment of soils and production of composts.

Fungi of the genus *Trichoderma* actively synthesize cellulase

enzymes that are able to deep destruction of plant cell walls and also difficult hydrolysable plant polysaccharides such as cellulose, hemicellulose, pectin [3, p. 39]. It is also known that these micromycetes secrete various metabolites: growth factors (auxins, cytokines, and ethylene), organic acids, intracellular acids, vitamins, and over 100 antibiotics. Cellulolytic enzymes are widely used in technological processes in various sectors.

Table 1 shows the main areas of application of cellulases.

**Table 1**

Main areas of application of cellulase

Name of industry	Using
Food industry	Extraction and clarification of juices, nectars Obtaining carotene and food dyes Softening of raw materials Reducing viscosity when mixing raw materials Improving the filtration of malt in the production of alcoholic beverages Acceleration of saccharification and fermentation processes
Detergent production	Adding as an enzyme supplement to synthetic detergents
Textile industry	Changing the surface properties of textiles due to biopolishing, bioscorning, softening

Pulp and paper production	Softening of cellulosic raw materials Bleaching pulp Clarification of recycled fibers Recycling
Agriculture	Application as a feed additive to increase nutritional value Application for harvesting forage
Biofuel production	Participation in the hydrolysis of cellulose and lignin-containing raw materials for the production of bioethanol

Using cellulases allows the implementation of waste-free technologies. Thus, the process of removing cellulose from different food and production of glucose occur after activation cellulolytic enzymes. Subsequently, glucose can be exploited for food processing, for making feed protein preparations and alcohol. Cellulases are added to food products in order to reduce viscosity and improve malt filtration in the production of alcoholic beverages and juices for softening vegetable and fruit fibers, in maceration of plant material for easier extraction aromatics. In addition, *Trichoderma* is used to make carbohydrate-containing gelling concentrate for confectionery [1, p. 112].

Cellulases have been most successful in the textile industry. These enzymes are used for fabric dressing, when it is possible to pumice, polish, soften fabric products with enzymes. Cellulases are involved in defibrillation of fibers and elimination of the pilling effect on new hydrated cellulose fibers of cloth. When cellulase is added to boiled solutions, the primary wall of textile fibers is destroyed and

various contaminants are removed. Cellulolytic enzymes are a part of detergents and washing powder [1, p. 120].

*Trichoderma* strains are engaged in wood and paper industries. Enzymes of *Trichoderma* activate hydrolysis and specific modification of fiber carbohydrates, take part in wood pulp processing, paper making and in the technology of dye release from the fiber surface.

Recently, experiments in exploitation of cellulases are carried out to ferment biomass for manufacture of biofuels. The producing of transport bioethanol from wood waste involves enzymatic hydrolysis of cellulosic biomass. As a result of this process, the structural integrity of cellulose, hemicellulose and lignin destroys [4, p. 737].

As a conclusion, the application of cellulases in biotechnological processes allows the rational use of raw materials and resources, which contributes to the development of waste-free production. Further research of *Trichoderma* producers will reveal new possibilities of these fungi in improving biotechnological processes.

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## **DIFFERENTIAL SCANNING CALORIMETRY AS ONE OF THE METHODS FOR DETERMINING THE THERMAL BEHAVIOR OF THE HYALURONIC MACROMOLECULAR ACID-XANTHAN SYSTEM**

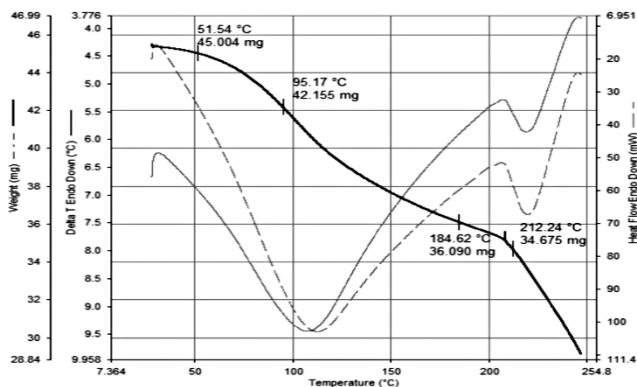
According to previous studies on the process of ionotropic gelation involving glucuronic acid residues [1] and  $\text{Ca}^{2+}$  ions contained in calcium chloride solution, we have studied in more detail. Solid-phase dehydrogenation, with the participation of which chelate is formed, was established for the system  $\text{AlgNa-Ca}^{2+}$  [2] and low-esterified pectin. Based on the specificity of the structures of hyaluronic high molecular weight acid and xanthan, such formed hydrogel is used in various industries. Xanthan and high molecular weight hyaluronic acid have attracted attention due to their biodegradability, non-toxicity, low cost and easy availability. One of the methods for studying the thermal properties of films formed from gels based on uronate polysaccharide compositions is the method of differential scanning calorimetry (DSC), which consists in determining the basic thermophysical characteristics of the studied objects using a calorimeter.

The sample was a xerogel of hyaluronic macromolecular acid and xanthan belonging to the class of uronant polysaccharides, with a total concentration of 3%. The sample that was made on the basis of this mixture was in the ratio of 1.5: 1.5: 0.5. Considering previous research, this concentration provides stable strength of the formed matrix.

A general technique was used to make the sample, namely a

solution of calcium chloride dehydrated with a mass fraction of 0.5%, which was applied by aerosol to the surface of the hydrogel, followed by drying in air. The structuring time of this gel was 48 hours.

The structuring took place in several stages. In the first stage, a hydrogel phase was formed, which is a high molecular weight solution based on the composition of uronate polysaccharides. Crosslinking was due to high chemical potential, due to strength, elasticity and transparency. This system contains a large number of polymeric polysaccharide fibers, retains a large amount of external moisture. We can say that the amount of internally binding moisture will be different. Taking into account the amount of lost externally bound moisture and calculations of the temperature difference ( $\Delta t$  of the sample is  $44^{\circ}\text{C}$ ), we can say that the moisture in this sample is not lost at the same rate, but at different temperatures, there is also a loss of sample weight.



**Fig. 1** - The results of determining the parameters of the characteristics of the TG sites of the dependence obtained for the system «hyaluronic macromolecular: xanthan:  $\text{Ca}^{2+}$ »

The second stage involved the formation of complex compounds  
- calcium uronates by aerosol spraying. This study of the behavior of the



sample took place under higher heating and the study of the process of loss of internally bound moisture. The initial temperature of the second peak of the weight loss process is in the range of 184... 212°C. When the sample was heated to the specified temperature range, the loss of internally bound moisture was 32% by weight of the sample at the end of the first peak of thermogravimetry.

The data obtained indicate that the polymer structures of polysaccharides retain the same amount of internally bound moisture. The difference in scan temperatures indicates active moisture loss with a lower concentration of polysaccharides. The temperature difference is 34°C. The total moisture loss for the test sample was 31%.

Based on the above information, we can say that the combination of such xerogels can predict such a system as a food and medical ingredient with several functions of biological action on the human body.

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## ANALYSIS OF LAYERED STRUCTURE CHARACTERISTICS AS A DIGITAL FILTER

In many areas of applied physics you have to face the problem of determining layered structures characteristics by their parameters [1-2]. Using classical methods to solve them [3] leads to unreasonably large computational costs when solving the inverse problem [4]. Thereby, it becomes actual to use fast and effective algorithms for these tasks, that proved their success for digital signal processing [5-6].

Considered approach based on the fact that reflectivity from a layered structure can be defined by recursive formula:

$$R_i = \frac{r_i + R_{i-1}e^{-j2k_id_i}}{1 + r_iR_{i-1}e^{-j2k_id_i}},$$

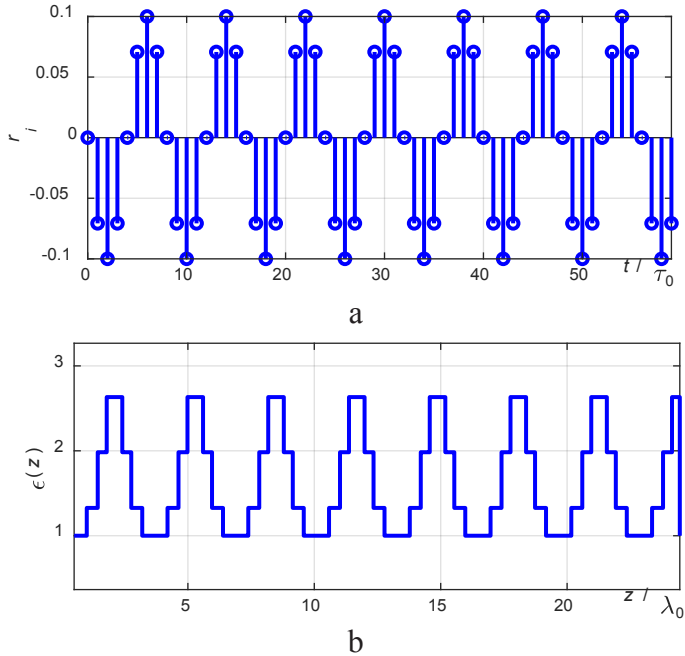
where  $r_i$  – reflectivity from  $i$ -th interface,  $k_i$  – wavenumber of the  $i$ -th layer,  $d_i$  – thickness of the  $i$ -th layer. For layered structure consisted of  $M$  layers, calculating by recursive formula starts from  $R_1 = r_1$  and ends with a definition of reflectivity from a whole structure, like  $R = R_{M+1}$ . For a layered structure that formed by layers with equal electrical thickness, using variable substitution  $z = e^{-j2k_id_i}$  allows to go to fractional rational representation of reflectivity [6].

$$R_i = \frac{\sum_{m=0}^{i-1} b_m^i z^m}{\sum_{m=0}^{i-1} a_m^i z^m} = \frac{r_i \sum_{m=0}^{i-2} a_m^{i-1} z^m + z \sum_{m=0}^{i-2} b_m^{i-1} z^m}{\sum_{m=0}^{i-2} a_m^{i-1} z^m + z r_i \sum_{m=0}^{i-2} b_m^{i-1} z^m} = K.$$

This implies that coefficients of polynomials can be computed

by recursive formulae of the following form:  $a_m^i = a_m^{i-1} + r_i b_{m-1}^{i-1}$ ,  $b_m^i = r_i a_m^{i-1} + b_{m-1}^{i-1}$ , starts from  $a_0^1 = 1$ ,  $b_0^1 = r_1$  and ends with  $a_m = a_m^{M+1}$ ,  $b_m = b_m^{M+1}$ , where  $m$  changes from 0 to  $M$ .

Lattice realization of a digital prediction error filter is based on such recursion and allows to go to use calculating algorithms of lattice filters for layered structures computing that is represented in a variety of software environments. An example of applying this approach is demonstrated in Fig. 1, that shows the given distribution of values  $r_i$  (a), profile of dielectric constant of the structure (b), Fourier transform for  $r_i$  (c) and a structure reflectivity  $R$  obtained as a result of calculations (d).



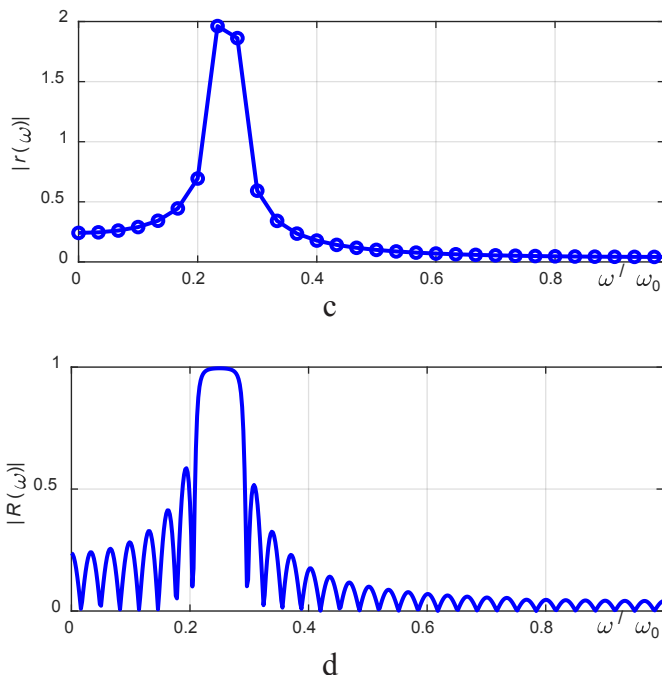


Fig. 1. Calculation results of layered structure as a digital filter

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## **PROSPECTS FOR BIOETHANOL PRODUCTION FROM CORN IN UKRAINE**

Bioethanol production belongs to the field of industrial biotechnology, which carries out large-scale bioproducts production in all sectors of biotechnology, as well as directly to the field of bioenergy. In the energy strategy, one of the priority directions of scientific and technological progress is the expansion of production and use of fuels obtained from various biomass types [5].

Biofuel is a fuel that is made from biological raw materials, obtained, as a rule, by processing sugarcane stalks or seeds of corn, soybeans, other grain crops and their waste. Liquid biofuels include bioethanol, which is currently an attractive alternative to fossil fuels, which are considered to be the main cause of air pollution, not to mention the fact that oil sources are finite [3].

The main advantage of bioethanol is its ease of integration with the existing fuel system for vehicles – bioethanol can be easily mixed with gasoline (up to 15%) without any engine modifications. According to Bill No. 7348, from July 1, 2020, the total capacity of bioethanol for gasoline sold in Ukraine must be at least 7% [9]. With such a content of biocomponents in gasoline, the need for bioethanol is at least 450 000 tons per year. Whereas, the total volume of bioethanol production in 2019 in Ukraine made up only 70 000 tons [10].

A mixture of ethanol with gasoline is characterized by high anti-knock properties, efficiency of the combustion process, compression

ratio, and increased octane number. It was found that bioethanol as an additive to gasoline improves the fuel performance [1, 6]. Nowadays, there are about 10 state sugar and alcohol factories in Ukraine that are engaged in the bioethanol production, as well as several private enterprises that use molasses and grain crops as a feedstock.

Corn is an attractive raw material for bioethanol production in Ukraine. Only in the Dnipropetrovsk region, the sown area of corn is 314 thousand hectares. In addition, the adjacent Poltava region is generally a leader in the corn cultivation, the sown area of which is 660 thousand hectares [10]. The production of bioethanol leads to emissions of carbon dioxide into the atmosphere, but this negative effect is offset by the demand for an increase in the corn sown areas. It has been found that corn is able to absorb carbon dioxide as it grows.

The yield of bioethanol depends on the processing technology, the content of hydrocarbons in the feedstock, since it is the sugar monomers that undergo further fermentation to ethanol (table 1)

Table 1

**Bioethanol yield depending on feedstock [7]**

The feedstock	Hydrocarbon content, %	Bioethanol yield from 1 ton of raw materials, tons
Rye	62	0,32
Wheat	58	0,3
Potatoes	18	0,098
Corn	60	0,29
Sugar beet	16	0,073
Wood	50	0,34

For the production of 1 kg of bioethanol, about 3 kg of corn is needed, it makes this feedstock very profitable, since the average

market cost of bioethanol is 17 315 UAH per ton, while the average market cost of raw material (corn) is just 2 722 UAH per ton [8].

The biotechnological process of the bioethanol production from corn is as follows: corn undergoes a lot of preprocessing steps before it can be considered ready for fermentation. First of all, corn is shelled to remove kernels from the cob, followed by separation from impurities, such as stones. Next, a commercially well-established biotechnological process is carried out via three steps: 1) conversion of starchy feedstock into fermentable sugars via three major sequential unit operations: milling, liquefaction and enzyme-based saccharification, followed by 2) fermentation, where yeast metabolically converts these sugars into ethanol. The final step is 3) purification, where the ethanol is separated out from other byproducts and impurities by distillation before it is stored or transported to market.

Based on how the grain is milled for ethanol production, milling is classified into two methods: wet milling and dry milling. If the grain is soaked in water to fractionate it into its individual components, such as starch, fiber, and germ, then it is called the wet milling process, whereas if the whole grain and the residual components are separated at the end instead of the beginning of the process then it is called the dry milling process. The main difference between the two milling processes is whether the whole kernel is processed as a whole – dry milling or the corn grain is first broken down into its individual components (germ, fiber, gluten and starch) and then sent for processing – wet milling. After dry milling, the raw material contains all grain fibers, husks, etc. Dried distillers grains with solubles (DDGS) are a co-product of dry milling ethanol production and are used as a high-protein animal feed. It is an

efficient alternative to corn and soybean-based animal feed. Wet milling plants for ethanol production use a pure substrate without fibers and vinasse. The productivity of such deep processing of grain is higher, but in this case the DDGS is not produced [4, p. 51].

Such technologies can be easily implemented in already existing enterprises with certain equipment and experienced specialists. For example, for starch factories and distilleries, the introduction of a bioethanol production line can be regarded as a product diversification, which leads to the financial stability of Ukrainian enterprises, ensure Ukraine's compliance with the Paris Agreement, aimed at combating global warming by reducing carbon dioxide emissions [2]. Large-scale bioethanol production will be the first step towards energy independence for Ukraine.

To conclude, the development of bioethanol production is a necessity these days, because exhaustible natural resources are receding into the background, and alternative energy sources are coming to replace them. The bioethanol production in Ukraine would be a good alternative to traditional fuel. Nevertheless, the production of this type of biofuel in our country is only at the beginning of its development. Modern production technologies and raw material base make it possible to manufacture a quite efficient and cheap product in comparison with traditional gasoline. The main condition for the functioning of the Ukrainian bioethanol market is the legislative regulation of the mandatory use of ethanol in the gasoline production and the introduction of direct subsidies for the enterprises that produce biofuel. Subsequently, it will create a demand for bioethanol in the domestic biofuel market and



improve the capacities of state and private plants.

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## **EMERGING ANTIMICROBIAL RESISTANCE POSES NEW GLOBAL THREAT**

The actual problem today is microorganisms that are resistant to antibiotics. They are called superbugs or multidrug-resistant bacteria. This type of bacteria has appeared from the long-term use of antibiotics by humans. Unfortunately, many antibiotics given to humans and animals are unnecessary. And the abuse and misuse of antibiotics contributes to the creation of drug-resistant bacteria. Microorganisms can constantly adapt by transferring genetic material between different species. This led them to resistance [2].

Every year, a huge number of people are exposed to infections that have been caused by superbugs. Antibiotics do not work well for some infections. This could lead humanity to a global epidemic. Moreover, by about 2050, deaths from infections caused by superbugs will exceed deaths from cancer [5].

«Superbugs require super antibiotics». The emergence of new types of resistant bacteria, which are dangerous to humanity, require the creation of new antibiotics, which will be of better quality than the previous ones. Modern microbiology and biotechnology are working to study this problem. But scientists have found another way to combat this enemy - blocking the bacteria feeding channel. These "gates" are composed of a beta-structured protein. If this channel is blocked, the bacteria will die from lack of nutrition. Another way to save humanity from superbugs is to turn off the gene mutation mechanism. It is much more difficult to fight

bacteria with a double cell membrane, that is, gram-negative bacteria [1]. The most dangerous bacteria are Baumann's Akinetobacter, *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus aureus* and Enterobacteriaceae. these bacteria are resistant to third generation carbapenems and cephalosporins [3].

In addition, infection of a person with superbugs is accompanied by the same symptoms as with infection with common pathogens. The nuance is that the treatment of this disease will take longer, and the symptoms will get worse [4]. A person can get an infection even through plant foods. Vegetables or fruits that a person eats could be treated with antibiotics, which leads to an unconscious entry of this antibiotic into the body [1]. This is what causes microbial resistance.

To protect yourself from the negative effects of superbugs, you need, in addition to washing, to use a disinfectant for your hands. watch your immunity, eat right, and control your sleep. it is also necessary to use antibiotics only for the intended purpose and at the right time [4].

The purpose of the study was to summarize knowledge about dangerous bacteria and to warn people against infection. Containing the proliferation of superbugs is a challenging task that requires joint action by healthcare, patients, and even government professionals [2].

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## ON SPECIAL CLASSES OF SCHEDULING THEORY PROBLEMS

A number of applied problems in a variety of different areas as biology, chemistry and economics can be effectively researched and solved using a mathematical apparatus, particularly mathematical modeling. Appropriately chosen from the existing ones or originally developed model allows to formalize practical formulations and choose from known or develop new solution-searching algorithms and methods.

Discrete optimization problems have an important place among such models. The one part of this class that is widely and actively researched nowadays is called scheduling theory which also consists of different subclasses of problems. Particular attention is paid to the problems connected to the situations when the finite set of jobs is needed to be done by the finite set of resources (workers, processing units, etc.) [3]. They belong to *NP*-complete problems. For this class, the following hypothesis is presumed to be true: for *NP*-complete problems, polynomial complexity algorithms which give an exact solution of them do not exist.

One of these problems is called parallel ordering problems and described in [1] as the optimization problem on graphs. Here the jobs are represented as vertices and there are additional consistent technological restrictions on the order of jobs' performance. Thus the graph  $G(V, U)$ ,  $|V| = n$  is defined. To formulate it additional definitions are needed.

Definition 1. Oriented graph parallel ordering  $S$  is a successive placement of its vertices in a row, that each of them is placed in a unique position. In addition, if there is an arc between vertices  $i$  and  $j$  then  $i$  is placed in ordering more to the left than  $j$  is.

Definition 2. The length  $l(S)$  of the parallel ordering is the number of non-empty places in  $S$ .

Definition 3. The width  $h(S)$  of the parallel ordering is the maximal number of vertices in its single position.

The two basic formulations of the classical parallel ordering problem are the following.

Problem 1. For the given graph  $G(V, U)$  and the width of parallel ordering  $h$  minimize the length  $l(S)$ .

Problem 2. For the given graph  $G(V, U)$  and the length of parallel ordering  $l$  minimize the width  $h(S)$ .

In both cases presumed that each worker can perform any job with the same efficiency and the time each job is taken to be done is the same. Problem 1 is known as straight, problem 2 is usually called the reversed.

Another case is considered based on whether interruptions in jobs are possible or they are not allowed. Interruptions here are the occasions when the particular job's performance becomes inactive despite this job is not fully complete yet, and proceeds later. With the interruptions allowed it makes sense to conduct research only with jobs that are not equal in time of performance and accordingly with the weighted graphs [2]. For them, there is the important question of whether interruptions give a more optimal solution, and in the case of a

positive answer does it depend on the graph's structure? It was found that for graphs with isolated vertices there are specific examples where allowing interruptions improves the solution almost twice compared to the case in which they are absent. Cases with another graph structure need further consideration.

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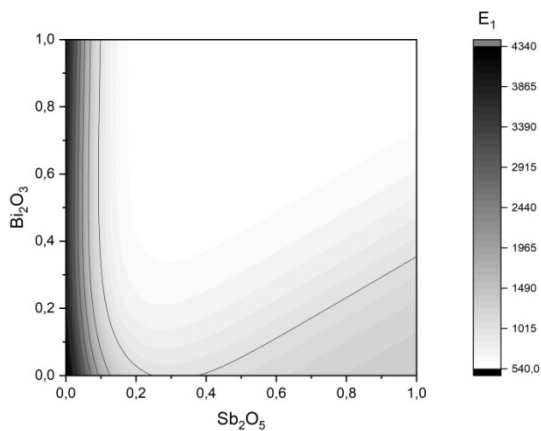
## **USING ARTIFICIAL NEURAL NETWORK FOR PREDICTING OF ELECTRICAL PROPERTIES OF VARISTOR CERAMICS BASED ON $\text{SnO}_2$**

Tin dioxide for the manufacture of varistor ceramics has been studied for a long time [1, 2]. A new surge of interest in the research of  $\text{SnO}_2$  varistors began after the production of low-voltage varistor ceramics based on tin dioxide [3], which has long been considered impossible.

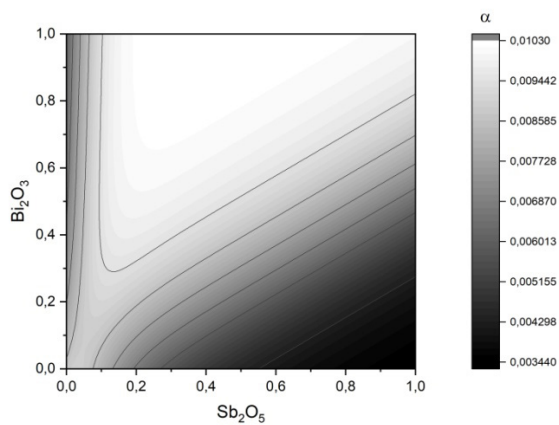
It is of great interest to study the possibility of predicting electrical properties and their optimization in varistor ceramics, for which we can use neural networks.

In work [4], a neural network was designed and we retrained it. We obtained two new varistor ceramics with different concentrations of additions  $\text{Bi}_2\text{O}_3$  0.9 and 1.0 mol.% for test results.

Maps with new predicted data for  $E_1$  and  $\alpha$  are provided in Fig. 1. The breakdown electric field has low values in the ceramics with high concentrations of additions  $\text{Bi}_2\text{O}_3$  and  $\text{Sb}_2\text{O}_5$ . The  $\alpha$  has high values in the ceramics with addition  $\text{Bi}_2\text{O}_3$  in range 0.6 – 1 mol.% and addition  $\text{Sb}_2\text{O}_5$  in range 0.8 – 1 mol.%.



a



b

Fig. 1. Predicted values for breakdown electric field  $E_1$  (a) and nonlinearity factor  $\alpha$  (b)



Table 1. Electrical properties of the  $\text{SnO}_2$  based ceramics - 3 mol.%  $\text{Co}_3\text{O}_4$  - 0.05 mol.%  $\text{Cr}_2\text{O}_3$  – 0.95 mol.%  $\text{Sb}_2\text{O}_5$  with addition of  $\text{Bi}_2\text{O}_5$  in comparison with the neural network predictions.

	$\text{Bi}_2\text{O}_3$	$\alpha, \text{V cm}^{-1}$	$E_1, \text{cm V}^{-1}$
Old prediction	0.9	0.013	1758
Real value		0.02	61
New prediction		0.01	562
Old prediction	1	0.015	2033
Real value		0.034	35
New prediction		0.01	552

Table 1 shows data for old neural prediction, real varistors and new neural network prediction for  $E_1$  and  $\alpha$ . We can see that new neural network provided more closer data for breakdown electric field  $E_1$  but new values for nonlinearity factor  $\alpha$  a bit farther from previous prediction.

Using neural network new varistors were synthesized with extremely low breakdown electric field  $E_1$  and high nonlinearity factor  $\alpha$ .

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## **FEATURES OF THE STRUCTURE AND REACTION OF FORMATION OF CHLORIDE $\pi$ -COMPLEXES OF COPPER (I) WITH FUMARIC ACID IN AQUEOUS SOLUTION**

Transition metals, due to ( $d\pi$ - $p\pi$ ) bonding with unsaturated carboxylic acids, are able to form chemically stable complex compounds in a wide range of oxidation states of the central atom. In particular, copper  $\pi$ -complexes are of interest due to their valuable antibacterial properties [3].

Earlier it was found [1, 2] that water molecules in the inner coordination sphere stabilize  $\pi$ -complexes of  $\text{Cu}^{2+}$  with the molecular form of maleic acid. At the same time, chloride ions in the inner coordination sphere increase the energy effect of the formation of mixed chloride maleic  $\pi$ -complexes. Therefore, it was interesting to study the effect of chloride anions on  $d\pi$ - $p\pi$ -binding of copper (I) ions with fumaric acid (FA). The technique of quantum chemical calculations is given in [1].

As in the previous study [2], chloride fumaric  $\pi$ -complexes  $\text{Cu}^{2+}$  can contain up to two water molecules at the maximum. The exception is chloride  $\pi$ -complexes with completely dissociated FA as a ligand, in which only one water molecule is maximally contained in the inner coordination sphere. At the first stage, the optimization of mixed chloride  $\pi$ -complexes  $\text{Cu}^+$  with different numbers of water molecules in the inner coordination sphere was carried out, as a result of which the Sum of

electronic and zero point energy were calculated (table 1).

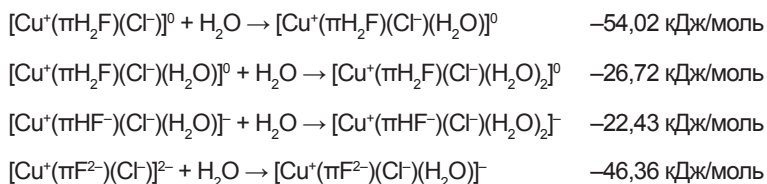
It was found that the  $\pi$ -complex  $[\text{Cu}^+(\pi\text{HF}^-)(\text{Cl}^-)]^-$  despite any optimization attempts, turned into a  $\sigma$ -complex  $[\text{Cu}^+(\sigma\text{HF}^-)(\text{Cl}^-)]^-$  that is, destruction of  $\pi$ - the bond between the  $\text{Cu}^+$  ion and the  $\text{C}=\text{C}$ -fragment of the acid (6).

As shown by the results of the study in [4], this fact is reliably caused by the peculiarities of using the relatively outdated method of the polarization continuum PCM.

Table 1. Total electronic energies of  $\pi$ -complexes of general composition  $[\text{Cu}^+(\text{H}_2\text{O})_n(\text{Cl}^-)(\text{FA})](\text{H}_2\text{O})_{(2-n)}$

$[\text{Cu}^+(\text{H}_2\text{O})_n(\text{Cl}^-)(\text{FK})](\text{H}_2\text{O})_{(2-n)}$	E, H
$[\text{Cu}^+(\pi\text{H}_2\text{F})(\text{Cl}^-)]^0$	-2709,454247
$[\text{Cu}^+(\pi\text{H}_2\text{F})(\text{Cl}^-)(\text{H}_2\text{O})]^0$	-2709,474823
$[\text{Cu}^+(\pi\text{H}_2\text{F})(\text{Cl}^-)(\text{H}_2\text{O})_2]^0$	-2709,485001
$[\text{Cu}^+(\pi\text{HF}^-)(\text{Cl}^-)]^-$	—
$[\text{Cu}^+(\pi\text{HF}^-)(\text{Cl}^-)(\text{H}_2\text{O})]^-$	-2709,032673
$[\text{Cu}^+(\pi\text{HF}^-)(\text{Cl}^-)(\text{H}_2\text{O})_2]^-$	-2709,041217
$[\text{Cu}^+(\pi\text{F}^{2-})(\text{Cl}^-)]^{2-}$	-2708,552192
$[\text{Cu}^+(\pi\text{HF}^-)(\text{Cl}^-)(\text{H}_2\text{O})]^-$	-2708,569850

At the second stage, various reactions with the participation of mixed fumarate  $\pi$  complexes of Cu (I) were modeled. In particular, the reactions of the sequential addition of a water molecule to the internal coordination sphere:



It can be seen from reactions (1) and (2) that the addition of the second water molecule to the inner coordination sphere of mixed chloride  $\pi$ -complexes with the molecular form of FA proceeds with 1.5 times less energy effect than the addition of the first water molecule. It is also possible to observe a slight decrease in the energy effect of the addition of the first water molecule to the inner coordination sphere with a decrease in the degree of dissociation of the FA molecule (in the series  $\text{H}_2\text{F} \rightarrow \text{HF}^- \rightarrow \text{F}^{2-}$ ) in the composition of these complexes.

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## **ACOUSTIC METHOD OF DESTRUCTION OF VIRUSES BY INFLUENCE ON THE BODY BY ACOUSTIC OSCILLATIONS**

Currently, the most common diseases of the nose and mouth are viruses. They cause great discomfort to everyone and there is also a high risk that they will develop into a more serious illness. They are treated in various ways and methods, but sometimes the treatment does not give the desired result, because the viruses are able to assimilate to certain drugs when overused, which also poses a great threat to human life. The new COVID-19 virus and its strains are especially dangerous.

In the case of the introduction of local wars in the world, the incidence of military personnel was caused by diseases caused by viral carriers. For example, the incidence of viral infections was observed during the Arab-Israeli conflicts in the UN troops in the Middle East. During the Falklands crisis, one of the main problems for the medical service of the conflicting parties was the prevention of airborne infections. In these situations, the sanitary losses from infections far exceeded the losses from weapons. This created great stress in the activities of the medical service and led to high economic costs. Leading in the pathology of personnel diseases can be pathogens of particularly dangerous severe viral infections (smallpox, plague, Ebola, etc.). This requires priority anti-epidemic measures on the part of the medical service and logistics, the Ministry of Health and the Ministry of Emergencies. The action of American troops in Operation Desert Storm

and during the occupation of Iraq, as well as NATO and UN contingents in Yugoslavia, was not accompanied by high morbidity, as effective preventive measures were taken to organize water supply, nutrition and sewage treatment. However, no special medical devices have been observed to kill viral infections.

That is why it is important to find new methods of combating viral diseases.

The aim of the work is to develop and implement an alternative method of destroying viruses by the action of acoustic oscillations on the body of the virus.

The following tasks arise:

- to substantiate the choice of acoustic method;
- to prove the effectiveness of the acoustic method of destroying viruses;
- to create an acoustic way to destroy viruses;
- to make preliminary calculations of the main characteristics: body weight of the virus, frequency and amplitude of the characteristics of the acoustic field that adversely affects the virus.

In this paper, an analytical review of existing methods of virus destruction and the relevance of finding a new method of viruses.

A comparison of ways to fight viruses, and identified three main ways to fight, namely – vaccination, interferon and chemotherapy.

The advantages of the method over others are:

- treatment of viral diseases without harm to human health;
- the use of non-existent drugs for the treatment of patients, which often cause allergic reactions, and a purely mechanical vibrational effect on the nasopharyngeal cavity [1].

Preliminary calculations of the main mechanical characteristics of the body of the virus: weight, body volume, resonant frequency, which will be detrimental to the body of the virus.

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## **TRIETHANOLAMINE SALTS ABSORPTION ON THE SURFACE OF THE SINTER DURING SINTERING PRODUCTION**

The sinter production processes at metallurgical plants are a complex physicochemical process occurring in a multiphase system. The pelletizing of the sintering mixture before processing it in the sintering machines determines many important qualities of the produced metal. In addition, pelletizing sharply reduces the intensity of dust and harmful gases entering the atmosphere together with sintering agents, which is an extremely urgent environmental problem.

The pelletizing parameters depend on the mineralogical composition of the mixture, its dispersion composition, humidity, degree of the hydrophilization of the particles surface. For pelletizing the mixture, water is added. However, its use does not always provide the required degree of pelletizing. First of all, this concerns the small fractions of the sintering mixture, the presence of which in the sintered charge leads to the deterioration of the sintering process itself, and also causes emission of dust particles into the waste gas ducts of the sintering plants. It is shown that the use of surfactants as wetting additives improves the quality of obtained sinter and reduces the content of dust and harmful gases in the waste sintering gases [1-3].

For the studies of sinter charge wetting, an anion-active surfactant based on triethanolamine salts (TEAS) was chosen. TEAS is a biologically mild surfactant, it is produced by the industry



of Ukraine and other countries and has a relatively low market price. The physicochemical characteristics of surfactant solutions were established in the processes of their interaction with the surface of polydisperse solid phase. On this basis the optimal parameters of bulk solids treatment were determined to improve the quality of the sintering mixture in the sinter production.

When studying the surface tension of aqueous surfactant solutions, its functional dependences on the concentration of TEAS were obtained. The form of the obtained isotherms is typical for surfactant solutions, but the influence of the solvent is promising. It was found out that a twofold decrease in surface tension is achieved in distilled water at the surfactant concentration of 3.5 %, in tap water at the concentration of 2 %, and in sea water at the concentration of 1 %. The magnitude of the calculated adsorption and the shape of the adsorption isotherm depend on the nature of the solvent. The adsorption from solutions that are made with seawater is closest to the Langmuir isotherm. The calculated value of the adsorption limit is 0.00365 mol/m<sup>2</sup>.

In solutions prepared with seawater, the adsorption values close to the limit are achieved at lower surfactant concentrations; seawater also provides better surface wetting, as is established by the measurements of the contact angle of wetting. It can be assumed that this is due to the chemical nature of TEAS ( $\text{R-CH}_2\text{OSO}_3\text{N}(\text{C}_2\text{H}_5)_3$ ), where  $\text{R} = \text{C}_{11} - \text{C}_{17}$ ) and the weakly alkaline reaction of seawater (pH 7.5 - 8.4). The polarity of the sulfogroup under such conditions increases, which enhances the surface activity of TEAS by 3.8 times compared to the activity in distilled water.

The measured and calculated adhesion work and rupture

force for bulk materials allowed to determine the optimal concentration of TEAS in the pelletizing solution: 0.00015 - 0.00020 mol/l at the consumption of 70 - 80 g per ton of the sintering mixture. It is noted that not only a decrease, but also an increase in the TEAS concentration relative to the optimum value leads to a noticeable deterioration in the sintering mixture quality. This may be due to the deterioration of surface wettability on the account of dimensional effects.

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## **FEATURES OF BINDING of $\pi$ -COMPLEXES OF COPPER ATOMS WITH SOME UNSATURATED ACIDS**

To control the structure and properties of copper precipitates released by electrochemical reduction of  $\text{Cu}^{2+}$  ions, additives of various organic substances containing a vinyl fragment are widely used. It is known that  $\pi$ -ligands form stable complexes not only with d-metal ions in the lowest oxidation states, but also with neutral atoms [1 – 2].

In this work [3], the analysis and the possibility of the formation of  $\pi$ -complexes of  $\text{Cu}^0$  with acrylic (HA), maleic ( $\text{H}_2\text{M}$ ), and fumaric acids ( $\text{H}_2\text{F}$ ) in the presence of water has been carried out using modern methods of quantum chemical modeling [4].

As expected, copper atoms form the limited number of stable complex forms. So, with HA there are only three structures, two of them with the molecular form of the ligand, with  $\text{H}_2\text{M}$  – five structures, three of them with the molecular form of the ligand, with  $\text{H}_2\text{F}$  – seven structures, three of them with the molecular form of the ligand. For comparison,  $\text{Cu}^+$  with the indicated ligands forms twenty-nine structures [4]. In complexes of  $\text{Cu}^0$  with molecular forms of acids, either only one water molecule (acrylate complexes) or two (complexes with diacids) can enter the inner coordination sphere. In complexes with ionized forms of acids, only one water molecule can be present in all cases. At the same time, attention is drawn to the fact that the electron-donating ligand, namely,  $\text{H}_2\text{O}$ , does not weaken, but, on the contrary, strengthens the

$\pi$ -complexes of atomic copper with unsaturated organic acids, which, by definition, upon  $\pi$ -bonding are electron-withdrawing ligands. It is characteristic that in complexes with dibasic acids, in which copper atoms can also hold the second water molecule, the charge of the central atom somewhat increases under its influence.

The highest occupied molecular orbitals of typical  $\pi$ -complexes of the studied group have been calculated and analyzed:  $[\text{Cu}^0(\text{H}_2\text{O})(\text{HA})]$  and  $[\text{Cu}^0(\text{H}_2\text{O})(\text{H}_2\text{M})]$ . As it turned out, copper atoms form a joint molecular orbital with only one carbon atom of the vinyl fragment. The greatest imbalance is observed in acrylate complexes. Here, the corresponding  $r_b$  values are 1.958 Å and 2.511 Å. An exception is the  $[\text{Cu}^0(\text{H}_2\text{O})_2(\text{H}_2\text{F})]$  complex, in which two symmetric molecular orbitals are realized (Fig. 1), as a result of which the  $r_b$  bonds of Cu-C<sub>1</sub> and Cu-C<sub>2</sub> take close values of 2.067 Å and 2.099 Å. In this complex, a sharp increase in the total energy of the  $\pi$ -bond is observed from -137.95 to -245.08 kJ/mol.

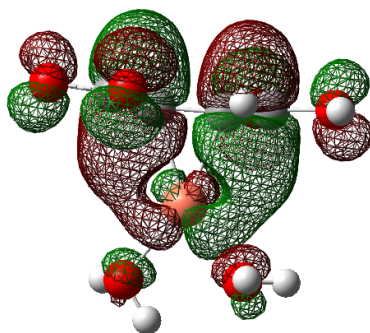


Fig. 1. Highest occupied molecular orbitals of some  $\pi$ -complexes of the studied group

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## **BIOLOGICAL PRODUCTS OF TRICHODERMA FUNGI IN PLANT PROTECTION**

Large losses before crop harvesting are caused by plant pathogens, such as viruses, bacteria, oomycetes, fungi, and nematodes. Among these, fungi are the major cause of losses in agriculture worldwide. Plant pathogens are still controlled through application of agrochemicals, causing human disease and impacting environmental and food security. Biological control provides a safe alternative for the control of fungal plant pathogens, because of the ability of biocontrol agents to establish in the ecosystem. Some *Trichoderma* spp. are considered potential agents in the control of fungal plant diseases. They can interact directly with roots, increasing plant growth, resistance to diseases, and tolerance to abiotic stress. Furthermore, *Trichoderma* can directly kill fungal plant pathogens by antibiosis, as well as via mycoparasitism strategies [1, p. 1].

Until 2003, all biological products based on these fungi were called trichodermin. The study of the properties of *Trichoderma* fungi for 55 years has shown that biocontrol strains are safe for animals and humans [2, p. 195]. The trichodermin preparation is obtained on the basis of the cultivation of the fungus on various natural substrates: waste products, 155 food or processing industry products (wood hydrolysates, molasses, vinasse, straw cutting, wheat bran). These substrates are enriched with mineral salts [3, p. 371].

Biological products are produced, as a rule, by specialized firms

or regional biological laboratories, mainly at the request of agricultural producers [2, p.195]. Fungal preparations used in plant protection against diseases can be divided into two groups: preparations based on live cultures of microorganisms-antagonists and hyperparasites, preparations based on antibiotics produced by fungi. The production of antibiotics is possible only at specialized biological industry enterprises with rather sophisticated technological equipment. Biologicals based on living cultures are available for preparation in biological laboratories or firms. The main formulations used for Trichodermin are dry and liquid (wet) formulations. The liquid form has, as a rule, a higher viability of spores, is not transferred by air currents, and besides, its production does not require drying costs. However, such a preparation is stored for no more than 2 weeks at a temperature not exceeding 12 ° C [2, p. 195].

Initially, Trichodermin was used outdoors to combat root rot in wheat and barley, but it is more widely used in greenhouses. When protecting plants from soil pathogens, seed treatment before sowing is most effective. 1-3 days before sowing, they are dusted with spore-mycelial powder. A single introduction of Trichodermin does not always provide sufficient efficacy, which necessitates multiple use of the drug.

When recommending a producer strain for creating biological products, as a rule, its ability to suppress a number of phytopathogenic fungi and the strain's manufacturability are taken into account. Recently, information has appeared that different species of the genus *Trichoderma* are also capable of producing phytohormones (auxins, ethylene, cytokinins) and, in addition to protective properties, have a direct stimulating effect on plant growth. Such effects of fungi of the genus *Trichoderma* on plant development are very important for their

application in agriculture and forestry, as well as for understanding the role of these fungi in natural and artificial ecosystems.

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## **BACILLUS AS PRODUCERS OF PLANT BIOSECURITY PRODUCTS**

The use of chemicals to suppress soil infections is often ineffective and environmentally unsafe [2, p. 3]. The use of microbiological products is an ecologically sound way to protect plants. These preparations are harmless for animals and humans, have no phytotoxicity or mutagenicity. They have a wide spectrum of action and a relatively low cost of development and implementation (compared to chemical pesticides) [1, p. 128].

Aerobic spore-forming bacteria of the genus *Bacillus* are considered promising agents of biological protection of plants against disease. This is due to the widespread natural antagonism to many microscopic fungi and the high adaptability to adverse environmental conditions. These microorganisms are not typical rhizosphere bacteria. But during inoculation of seed or planting material, they are capable of developing in the root zone of plants for a long time. The ability of *Bacillus* to develop in the plant rhizosphere and to compete with rhizospheric (including phytopathogenic) microflora is probably predetermined by species specificity. At the same time, the ability of bacilli to take root and carry out activities in the plant rhizosphere is influenced not only by biogenic factors but also by environmental conditions [2, p. 3]. They are successfully used to fight bacterial and fungal infections.

*Bacillus* produce various antimicrobial substances such as

cyclic lipopeptides and lytic tachinase enzymes. Lipopeptides produced by *B. subtilis*, *B. amyloliquefaciens*, *B. pumilus* (mycosubtiline, fengicins A and B, iturin) exhibit antifungal activity, whereas surfactin has a broad spectrum of antibacterial activity. In addition, the bacteria *B. amyloliquefaciens*, widely distributed in soils, synthesise amylolysin. It does not belong to the lipopeptides and inhibits the growth of mainly Gram-positive bacteria. Advantages of cyclic lipopeptides compared to chemical plant protection agents are their low toxicity, high biodegradation rate and safety for the environment. A strain of *Lysinibacillus sphaericus* has recently been isolated from the rhizosphere of maize, which, apart from its larvicidal metabolites, produces 2-pentyl-4-hinolinicarboxylic acid. This acid exhibits anti-fungal action of varying degrees against phytopathogenic fungi: *Alternaria alternata*, *Curvularia lunata*, *Aspergillus sp.*, *Sclerotinia sp.*, *Bipolaris spicifera*, *Trichophyton sp.* The *Bacillus* strains are part of the rhizosphere. They protect the root system from disease-causing organisms. They also produce biologically active substances which stimulate the growth and development of plants. They contribute to the solubilization of phosphates and silicates and induce an increase the resistance of plants to the stimulants of mycosis. They are the basis for the development of biologic preparations for the protection and improvement of livelihood of agricultural plants. Most of the developed microbial preparations for plant protection against diseases and pests are based on monocultures of microorganisms. Scientists have recently focused their efforts on the development of microbial preparations of complex action on the basis of microbial associations [3, p. 70]. The insecticidal activity of bacteria of the genus *Bacillus* makes it possible to use them not only against microorganisms

and fungi. They are also used as control agents against insect pests.

Bacteria of the species *Bacillus thuringiensis* are particularly valuable in this respect. They produce endotoxins and enzymes that have a specialised effect on a particular kind of insect larva. Crystalline proteins are regarded as the main toxicological bio-insecticides based on *B. thuringiensis*. Toxins and enzyme complexes are used to produce preparations against different rows of insects (*Lepidoptera*, *Hepidoptera*, *Beetles*, *Diptera*, etc.).

The use of antagonist bacteria of the genus *Bacillus* is environmentally beneficial and safe for humans and animals. These microorganisms are progressive plant protection agents due to their widespread natural antagonism and high adaptability to unfavourable conditions. The synthesis of specific metabolic products, different for many members of the *Bacillus* genus, makes it possible to develop biological preparations that not only protect plants against diseases and pests, but also improve their nutrition and stimulate growth and development.

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## **CHALLENGES IN DRUG DISCOVERY AND DEVELOPMENT GLOBAL AND UKRAINE OVERVIEW**

Nowadays one of the biggest markets is pharmaceutical, for example in 2014 global sales reached 1T\$, even more, some analytics making forecasts: about 1.5T\$ in 2021 [1].

At the same time, there are countless challenges in Drug Discovery, Development, and Commercialization. We will focus on the first one, also in medicinal chemistry for better understanding certain aspects.

It is worth noting that in Ukraine we have both specifics and global challenges.

Global Challenges include:

- R&D productivity moderately improved, drug approvals have not increased significantly but Development costs escalate;
- Expensive: On average, companies spend well over US\$1 billion to bring an approved drug to market (includes the cost of product failures along the way) [2];
- Risky: Fail can happen in the late phase and cost quite much;
- Slow: Taking a molecule from early research to an approved product takes over 12 years;
- Inflexible: The drug development process is also highly regulated by EMA, FDA, etc.;
- Under pressure: governments restrictions have an impact;

- Changing: patents expire, so generics number grow exponentially;

- Siloed: The R&D process is highly fragmented;

- I) Could be driven by the need to protect Intellectual Property (IP);

- II) Fail to learn from experiences and mistakes of others;

- III) Closed systems in all meanings.

Specifics of Ukraine:

- Lack of High degree programs

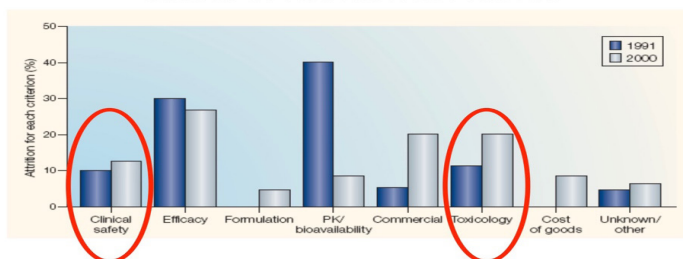
- Lack of investments

- Lack of well-equipped facilities

- Fear of potential investors making business here

The two key reasons for failure today are the lack of efficacy and toxicity. Combined their count for about a third, efficacy accounts for about a third, and then there are a variety of other causes, some of the economic, such as cost of goods, etc. which are making up the remaining third [3].

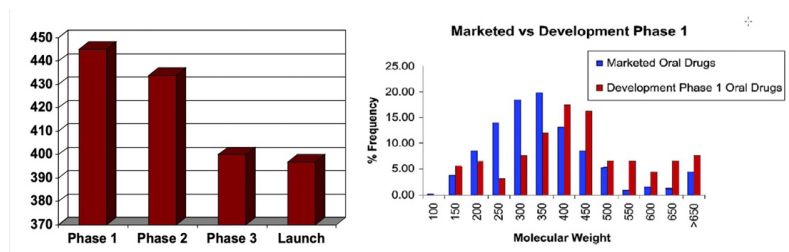
**Causes of Attrition in Pharma**



**How can MedChemists help address ~1/3 of Pharma Attrition?**

The same kind of convention has been developed for molecular weight [4]. That if you look at, the average molecular weight of an

approved drug, vs their snapshot of what was going on in, clinical development, you could see that on average, the smaller molecules have a greater success rate.



As you can see at marketed oral drugs histogram (right), centroid has considerably lower molecular weight than the snapshot of the phase 1 compounds.

We are trying to normalize potency for lipophilicity. If you put in some exemplar values and say you want your small molecule to bind very tightly, meaning better than 10 nanomolar IC<sub>50</sub>, and you want your cLogP to be less than three. That means your lipophilic ligand efficiency (LLE) needs to be greater than five.

So this is a way of keeping track of how much lipophilicity you are adding during the chemistry process and trying to ensure that you are not adding too much and you are getting potency for the right reasons, not the wrong reasons.

Conclusions:

The two key reasons for failure in pharma today are lack of efficacy and toxicity;

Related proteases interactions can be dangerous;

P450's = Major source of variability in drug response;

Interplay of the disciplines leads to successful target choice;

Genetic polymorphism – have a huge impact on metabolism;

The goal is to add potency, add the strength of binding without grease;

Nature is clearly favoring smaller or less lipophilic molecules as you're driving towards making a drug;

Patient-friendly delivery more favorable;

FBDD generates multiple opportunities;

Drug Discovery & Development: expensive, slow, under pressure, changing, risky, inflexible, siloed.

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## **MODERN PROBLEMS OF CANCER PATIENTS THROMBOSIS**

Today, everyone knows that patients with malignant neoplasms are much more prone to thromboembolism and thrombophilia, which complicates treatment and the course of the underlying disease, so in cancer patients the risk of thromboembolism is 4-7 times higher than in patients of other categories that are shown by modern multicenter researches [1,2].

And now all over the world doctors' attention is focused on solving the important problem of prevention and treatment of both clinically pronounced and latent thrombosis, which are detected as pathological findings at autopsy 3-4 times more often, that is why clinicians are looking for primary thrombosis and identifying features of its formation.

The main role in the pathogenesis of patients thrombotic complications with malignant neoplasms are attributed to changes in the hemostasis system caused by the cancer itself and the body's response to the malignant process (inflammation, focal necrosis, hemodynamic disorders). No less important factors are treatment measures: chemotherapy, hormone therapy and surgery. Adhering to the principle of maximum radical surgery, patients undergo significant interventions that require long-term immobilization in the postoperative period, which leads to an increase in the frequency of thrombotic complications [3, 4].

The initiation of coagulation is activated in response to triggers



such as damage of the vessel wall or intravascular aggregation of cancer cells or the entry of tumor cells into the bloodstream. The tumor cell activates the coagulation system or fibrinolysis system in order to further spread, ensure maximum angiogenesis, increase vascular permeability, which in turn promotes metastasis. The main role in this case belongs to the release of procoagulants and cytokines from tumor cells. Endothelial damage, decreased activity of coagulation inhibitors and fibrinolysis activators are also noted. According to studies, there is activation of both coagulation and vascular-platelet blood coagulation due to impaired structural and functional stability of vascular endothelium by tumor cells and cytokines, platelet activation by tumor cells, synthesis of procoagulants and inhibitors of fibrinolysis and inhibitors of fibrinolysis, fibrinolysis blood [4].

From the position about tumor development, the local phenomena within the tumor and on its surface, as well as external blood vessels, are of paramount importance. Fibrin formation is caused by tissue factor (TF), which activates factor X, then converts prothrombin to thrombin, after that fibrinogen to fibrin and stabilizes fibrin. It is, in turn, is a mechanical support for the tumor, a barrier for the immune system and the result of the activation of blood clotting. After tissue damage, fibrinogen is extravasated from blood vessels into the extravascular space with the formation of a fibrin matrix. Inflammatory cells and endothelial cells migrate into such a matrix and stimulate the repair process, which over time turns into mature vascularized connective tissue. Platelet adhesion to sub endothelial connective tissue components is due to the interaction of platelet glycoprotein receptors with the collagen of the sub-endothelial matrix, and thrombin in turn, in addition to participating

in the activation of coagulation, plays a significant role in tumor growth and its metastasis and acts as a proangiogenic factor, stimulating tissue plasminogen activator inhibitor, inhibiting the fibrinolytic system [4].

During autopsy of deaths from thrombotic complications in the relevant vessels thrombotic masses and thromboembolism can be seen. An important point is the differentiation between thromboembolism and postmortem blood clotting. Thromboembolism is characterized by the following signs: corrugated return due to the collet lines, brittle consistency, and usually completely obturate the lumen of the vessel, which is complicated by the appearance of ischemic infarction of the relevant tissues. At the same time, the postmortem clot of blood has a smooth shiny surface and elastic consistency and often lies freely in the vessel and does not correspond to the diameter of the vessel in which it is located. At first, they are easily removed from the vessel, but a few days later they can be connected to the wall, so it is difficult to distinguish them from a blood clot. It helps to detect fresher thromboembolism in other blood vessels. In most cases, the source is blood clots that form in the vessels of the inferior vena cava, namely: the deep veins of the thighs and legs and pelvic veins. Also a large catheter vena is often the primary site of thrombosis of cancer patients, where thrombi form early and often, thromboembolisms of this origin are mostly infected, and in case of separation from infected blood clots are usually small and small infarcts. However, common thromboembolisms are often long coiled, their diameter can be judged by their source, so if the diameter is more than 8 mm, the probable site of formation were thrombi from the iliac veins and inferior vena cava, rarely subclavian and jugular veins. Thromboembolism with a diameter of 5-8 mm is characteristic

of thrombi localized in the large femoral veins, and even smaller in the tibial and pelvic veins [5,6].

Thus, malignant neoplasms are a risk factor for thrombotic complications, and vice versa. However, not all cancer patients develop thrombotic complications. Against the background of a malignant neoplasm, thrombotic complications, such as deep vein thrombosis or pulmonary embolism, are often asymptomatic, but are often serious complications. Also it is fundamentally important that thromboembolism is not only a cause of death in itself, but also infection, joining a secondary infection can lead to more threatening conditions [4,6].

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## TIME IN MODERN PHYSICS

In an experiment carried out by Hafele und Keating [1], a cesium clock was moved eastward and westward around the globe and the clock that was flown eastward was observed and found to be slow by  $59 \pm 10$  ns when it returned, while the other one that was flown westward was early by  $273 \pm 7$  ns in comparison with a clock that was static, while the time shown should be the same [1]. So the question arises: is there something wrong with it or everything is alright? What would professionals say about that?

Some scientists, and Hartmut Traunmuller among them, may consider it wrong. According to the current way of thinking in Physics, these clocks measure time, and nothing else, but time is a relative notion. Time itself depends on motion and gravity. This concept was formulated by Einstein, who abolished the idea of “absolute time”, considering it as immeasurable and useless for Physics. Einstein’s conception allowed advances in Physics in the absence of any method of measuring absolute time in a physically objective way [2]. Traunmuller says that: “However, since the new concept of time is incompatible with the common one, which Galileo and Newton adhered to, relativity theory appears paradoxical to those who have not been adequately indoctrinated. Paradoxes arise when common sense notions are applied instead of the cranky notions required by the theory. Such paradoxes can never be resolved by any physical experiments, but only by analyzing of

how people reason.” and “Of course, the conceptual revolution initiated by Einstein would need a perestroika if it could be shown how time and spatial distances can be measured in agreement with common sense, i.e., without distortion by motion and gravitation” [2].

However, the others consider it to be the right thing. They say how we usually assume that time is an absolute physical value. But, they also say that we never really measure it. What we do measure – it is the object’s frequency, speed, etc. In other words, what experimentally exists it is the motion of an object and the tick of a clock, and we compare the object’s motion to the tick to measure the object’s movement. By itself time has only a mathematical value, and has no primary physical sense.

This doesn’t mean that time is non-existent, but that it has more in common with space than with the idea of an absolute time. While three dimensions of space and one dimension of time are considered a 4D spacetime, the researchers suggest that spacetime may be considered as four dimensions of space. In other words, the universe is “timeless” [3].

Scientists propose different numerous theories of time. Some of them consider that there is absolute time while the others may consider time as the 4th dimension. And these are only the few of them.

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## **THE ROLE OF BETA LACTAM ANTIBIOTICS IN THE MODERN TREATMENT OF INFECTIONS**

Antibiotics are medicines that fight bacterial infections in people and animals. They work by killing bacteria or by making it hard for bacteria to grow. Antibiotics are among the most frequently prescribed medications in modern medicine. The first antibiotic was penicillin, discovered accidentally from a mold culture. Today lots of different antibiotics are available to cure minor and life-threatening infections [1]. Although antibiotics are useful in a wide variety of infections, it is important to realize that antibiotics only treat bacterial infections. Antibiotics are useless against viral infections (for example, common cold) and fungal infections.

Nowadays there are over 100 different antibiotics, but the majority come from only a few types of drugs. There are the 7 main classes of them [1]:

1. Penicillins.

2. Cephalosporins.

Macrolides, such as erythromycin.

Fluoroquinolones such as ciprofloxacin, levofloxacin.

Sulfonamides such as co-trimoxazole.

Tetracyclines such as tetracycline.

Aminoglycosides such as gentamicin.

There are some groups that influence the creation of the cell wall of bacteria.

Penicillins and cephalosporins are the major antibiotics that inhibit bacterial cell wall synthesis. They are called beta-lactam antibiotics because of the unusual 4-member ring that is common to all their members. The beta-lactams include some of the most effective, widely used, and well-tolerated agents available for the treatment of microbial infections [2, p. 43]. According to statistics,  $\beta$ -lactams account for 65% of all prescriptions for injectable antibiotics [3].

The specificity of  $\beta$ -lactam antibacterials is due to their ability to inhibit transpeptidase enzymes and prevent the assembly of the peptidoglycan layer in both Gram-positive and Gram-negative bacteria.  $\beta$ -Lactam molecules, with their structural similarity to the D-alanyl-D-alanine group within the peptidoglycan structure, compete for the binding sites of transpeptidases. When it was first commercialized, penicillin, a  $\beta$ -lactam antibiotic, was considered a «magic bullet» because of its specificity for bacterial infections without harming the patient [4].

Vancomycin, fosfomycin, and bacitracin also inhibit cell wall synthesis but they interact with vector molecules and are not as important as the beta-lactam drugs. The toxicity of these drugs is mainly due to specific actions on the synthesis of a cellular structure that is unique to the microorganism. More than 50 antibiotics that act as cell wall synthesis inhibitors are currently available, with individual spectra of activity that afford a wide range of clinical applications.

Bacteria often develop resistance to  $\beta$ -lactam antibiotics by synthesizing a  $\beta$ -lactamase, an enzyme that attacks the  $\beta$ -lactam ring. To overcome this resistance,  $\beta$ -lactam antibiotics are often given with  $\beta$ -lactamase inhibitors as clavulanic acid [5].

Clavulanic acid inactivates some beta-lactamase enzymes that

are produced by bacteria, therefore preventing enzymatic destruction of amoxicillin. This helps to treat a variety of bacterial infections which would otherwise be resistant to antibiotics without the addition of clavulanic acid. It is indicated that clavulanic acid combined with other antibiotics is indicated to prevent the development of drug-resistant strains of bacteria and promotes their therapeutic antibacterial effects. The following conditions, when they produced beta-lactamases, have been treated with a combination of amoxicillin and clavulanic acid or ticarcillin and clavulanic acid [6].

To strengthen the effect of antibiotics and to prevent their harmful impact on organism, some drugs have been modified or have been semi-synthesized.

The second generation of cephalosporines «have an overlapping spectra with those of penicillin V potassium and amoxicillin formulations and are more  $\beta$ -lactamase resistant than the first generation cephalosporins» [7]. That gave possibility to make bigger impact on aerobic gram-positive cocci and bacilli. The third generation gives us more forms of cephalosporins and greater range of action, that allows receiving higher success rate [8]. The fourth generation has beta-lactamase stability and enhanced activity against gram-positive bacteria and pseudomonas. Both third and fourth generation are considered to have broad spectrum, while first and second have moderate spectrum [9].

Semi-synthetic  $\beta$ -lactam antibiotics are very effective anti-infective agents. They are very stable and can be used not by injections. «They exhibit a very wide spectrum of anti-bacterial activity and minimal side-effects after being massively used for a very long time» [10]. In this



way, we can assume that semi-synthetic  $\beta$ -lactam antibiotics are going to continue to be one of the key anti-infective agents for the next years. The condensation of natural or modified antibiotic nuclei with different acyl donor chains is one of the key steps for the industrial synthesis of these anti-infective agents.

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## **REVIEW OF METHODS OF DNA TRANSFECTION INTO EUKARYOTIC CELLS**

With the development of molecular biology, genetic engineering and gene therapy, the problem of transformation nowadays becomes more relevant, especially regarding the transformation of non-model organisms. Since both DNA – deoxyribonucleic acid – and cell membrane are electronegative, the step of DNA insertion into the cell – transfection – is one of the biggest struggles. The introduction of foreign DNA into non-model eukaryotic cells often has low efficiency and takes much time for the cells to recover. That is why the question of transfection improvement is being deeply investigated.

There are already a few relatively effective methods of DNA transfection into eukaryotic cells, which are divided into biological, chemical, physical, and mechanical approaches. Some techniques are of a very narrow range of applications, while other cause a high level of cell death, some are low-efficient. Still, several techniques are commonly used for transfections, as well as studied: electroporation, Calcium Phosphate-DNA Coprecipitate and Agrobacterium-mediated transformation.

The most widespread method is DNA transfection by electroporation. It is an established technique that applies to almost all cell types – bacterial, yeasts, fungal and animal. It yields a high frequency of stable transformants and has high efficiency of transient gene expression. The steady transformation frequency of this method

is approximately between 1 in  $10^3$  and  $10^4$  cells, depending on cell type [7]. In this method, pores in the membrane are created by high-voltage electric shocks, and during the time that the pores are open, the nucleic acid can enter the cell and ultimately the nucleus. The technique was generalized in 1984 [8] to all cell types, even those such as lymphocytes that, unlike fibroblasts, cannot be transfected with other procedures (e.g., calcium phosphate or DEAE-dextran DNA coprecipitates). It is important to mention, that this method is shown to be effective not only in vitro but also in vivo.

The second popular method is Calcium Phosphate-DNA Coprecipitate. This technique is also applicable to most eukaryotic cells. The frequency of stable transformation after transfection performed this way is about 1 in  $10^3$  cells [4]. In this method, DNA is usually diluted in isotonic saline with low phosphate concentration. After that, calcium chloride is added. The result is the formation of a calcium phosphate precipitate [1]. It is essential to have consistency in reagent properties, such as pH, to avoid compromised efficiency. The calcium phosphate method does not work for cells grown in media with high phosphate levels, such as RPMI.

The last method for the review is *Agrobacterium*-mediated transformation. This approach is popular for plant transformation, showing high results – up to 8 cells out of 10 [3]. Furthermore, there have been several studies approving the fact that *Agrobacterium* is applicable for fungi, yeast and animal cell transformation [2,5,6]. Still, the current method needs further investigations for different cells to approve or decline the reliability and possibility of wide usage of *Agrobacterium tumefaciens* in DNA transfection.

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## **THE ROLE OF OXYTOCIN IN SOCIAL BEHAVIOR**

Oxytocin (OT) is a natural neurophysical peptide hormone that is produced mainly in the hypothalamus and stored in the pituitary gland (whereof is transferred to the bloodstream), but it is also synthesized in the ovaries, endometrium and placenta. OT was the first peptide hormone to have its structure determined and the first to be chemically synthesized in biologically active form. It consists of 9 amino acid residues with the following sequence: Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-Gly-NH<sub>2</sub>; there is a disulfide bridge between two cysteine groups that makes the molecule cyclic [1, 2, 3].

The hormone was named after the «quick birth» (ωχvξ - quick; τοχoxξ - birth) which it causes due to its uterotonic activity, and was also found to be responsible for the milk-ejecting activity of the posterior pituitary gland. But there are a big number of other actions of the neuropeptide that range from the modulation of neuroendocrine reflexes to the establishment of complex social and bonding behaviors related to the reproduction and care of the offspring [1].

Such social behavior as love and social attachments (including parental care, nursing, social interaction, pair bonding, mutual defense) function to facilitate reproduction, provide a sense of safety, and reduce anxiety or stress. They are clearly opposed to the ancient self-preservative behaviours that take place when these balanced social interactions are disturbed (e.g., by a stressor).

These behaviors have been studied in North American species of voles (genus *Microtus*), where both minimally parental, promiscuous and biparental, monogamous (highly social) forms of social organization can be observed. Notably, the effects of exogenous OT on these two patterns differ. The neuroendocrine differences between monogamous and polygamous species reside on the corresponding receptor molecules: high OT receptor densities were only found in the prelimbic cortex and nucleus accumbens of social active species. Therefore, variable expression of the OT receptor in brain could be an important mechanism in evolution of species-typical differences in social bonding and affiliative behavior.

Oxytocin's action complexity on social behavior is demonstrated in the squirrel monkey, in which effects of exogenous OT depend on the prior social status of individuals: dominant males responded with increased sexual and aggressive behavior, subordinates displayed more associative behaviors. It is supposed that differential behaviors may be linked with the level of serum testosterone [1].

Concerning human models, the foundation of social affiliation and approach is trust in other people. Researches demonstrated that intranasal OT can substantially increase trust among human (45% of the participants in the OT group showed the maximal trust level compared to 21% in the placebo group). Actually, OT increased the individual's willingness to accept risks within social interaction, but not readiness to bear those risks.

In another behavioral study, participants were given a set of pictures showing the eye region of facial expressions. They were asked to infer the mental state of the depicted person, and a dose of OT administered intranasally enhanced the number of correct answers

compared to placebo group. OT improves the ability to infer the mental state of others. The same researchers showed a single intranasal administration of OT increases the subjective experience of attachment security (in male students classified with an insecure attachment pattern). Secure attachment is associated with lower stress reactivity and better ability to socially interact, and mediates the implications of early trauma, so namely on psychopathology, the neuroendocrine mechanisms of attachment may have direct clinical implications for several developmental and mental disorders [4].

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## **Секція 2**

*Актуальні проблеми  
соціально-гуманітарних наук*



## **RATIONALITY AND CHALLENGE**

Nowadays, the ideal of rationality is being shattered. Many people are seeking guidance from myths, dreams and superstitions rather than from science or intellect. It reminds us of a striking allegory: a group of men is walking in a line, each of them holding on to the shoulder of the man ahead, and the whole chain is guided by a blind man. Could folly really become man's guide? Many great philosophers racked their brains over how to build up an ideal state. The Athenian democracy, for instance, respected every man's right to express his opinion, but it was so full of surprises that every citizen took responsibilities at his own risk.

The great Plato was Socrates' pupil. His teacher's death, imposed by the verdict of the Athenian jurors, was one of the most shattering experiences of his youth. The ridiculousness of the charge and the obvious injustice of the trial stemmed, as Plato believed, from the lack of order in the local community. He decided to restructure it and create a new order out of chaos, by putting together all the scattered pieces to form an entity. Plato conveyed his ideas on ideal order in his treatise "The Republic". Annoyed by the confusion in the democratic state, he created something extremely well-balanced and orderly - a corporative state ruled by philosophers. Plato hoped to put his ideal system into practice with the help of the Syracusan tyrant Dionysius.

The outcome of this attempt was that Dionysius sold the philosopher into slavery, but that is irrelevant. What is important, is the reformer's striving to replace chaos with order and dispersal with

unity. By one act, beautiful in its purposefulness, he wanted to create a harmonious and orderly state, rationally organized and, therefore, perfect. Yet the longer the state of Athens existed, the more striking its disintegration, isolation and anarchy became. Plato, whose philosophy expressed the general yearning for reason by showing the aristocrats' annoyance with democracy, made people see how irrational they can be when trying to solve a problem. Regrettably, a state cannot be ruled by philosophers.

As for the experience of totalitarian regimes, it is even more shocking, for they lack any semblance of rationality. Dictators themselves create the prerequisites for the collapse of their own regimes. In doing so they waste enormous human resources and social wealth. There is no human measure in them at all. Another great humanist and mediaeval philosopher, Erasmus of Rotterdam, did not dwell on state problems. He remarked ironically in his famous book "The Praise of Folly" that the war was the very root and matter of all famed enterprises. And yet what was more foolish than to undertake it when both parties were sure to lose more than they could get by the bargain. And when both sides were close engaged and the trumpets made an ugly noise, there was no use of those wise men that were so exhausted with study that their thin, cold blood had scarce any spirits left.

So what is more common in human history, folly or wisdom? According to the book "Cynicism and passion" by the French philosopher André Glucksmann, it is wisdom that causes all human misfortunes. The book represents an essay of Western history, beginning from the first political moves in the state of Athens and ending with the presidential elections in France. The New Philosophers emerged in France in the

late 70s, and A. Glucksmann became their ideologist. Their doctrine had the effect of a stone falling into a swamp. They claimed to be “anti-bourgeois” from the very beginning. In a nutshell, their philosophy is a challenge to reason, especially abstract thinking, which the New Philosophers regard as the cause of all human misfortunes. According to them, it is reason, man’s ability to abstract himself from reality, which has caused many tragedies in European history. Reason became a fatal factor in many universal philosophies. The New Philosophers regard man’s rational activity as a violent and evil force threatening to seize the entire world. In their opinion, reason becomes an openly aggressive factor which both captures man from the inside and subjects him to its will from the outside, whether he likes it or not. In other words, it imposes its rigid principles on man.

According to A. Glucksmann, reason has not only captured man’s inner world but also penetrated into human history: nations have invented the image of the Commodore which now dominates the world. In peaceful times it seems to fade into the background, allowing peoples to have fun by its pedestal, but in times of crisis it suddenly comes alive and upsets the peaceful flow of life. Acting as determined defenders of overall personal emancipation, the New Philosophers nevertheless refuse to recognize man’s right to the free development of his natural abilities. They demand the cutting short of any attempt by the mind to grasp the meaning of life. They claim that a person who relies on his analytical abilities too much thus neglects other features of his personality.

That’s where the New Philosophers come in for sharp criticism. History shows that it was “autonomous thinking” that promoted man’s

humanization and asserted the dignity of Homo sapiens, who thus raised himself above his mundane existence. Besides, free philosophical thought has made an enormous contribution to the evolution of man's personality. Reason became the vessel of the salutary truth not through the nature or ambitions of the intellect itself, but through the continuous spiritual and cultural progress accumulating man's mental and moral potential. The philosophical school denies man's intellect and promotes the opposite category, the human body because this century sets store by the body: the lover and the sculptor contend for it against the executioner and the policeman. All the enigmas of the world are imprinted on the human skin. They speak the language of scars and deformities. That is why the New Philosophers set themselves the task of making our contemporary intellectuals see the deformed fact of existence.

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## **THE FEATURES OF PERCEPTION OF ADEQUACY AND EQUIVALENCE IN TRANSLATION**

To achieve the equivalence of the translation, in the absence of direct, complete equivalents, the translator must skillfully apply the transformations that are carried out in the transmission from the original text to the translated. According to L. S. Barkhudarov, translation can be considered an interlingual transformation in the broadest sense of the term [1, p. 7].

The concept of adequacy is frequently based on the concept of equivalence. Thus, for A. Popovich, the adequacy of translation is a stylistic and semantic equivalence in translation [5, p. 22].

V. Komissarov interprets equivalent translation and adequate translation as concepts that are not identical, but closely related. The term «adequate» has a broader meaning and is applied to translation, which provides the necessary completeness of interlinguistic communication under specific conditions. Adequate translation is a translation that provides pragmatic tasks of the translation act at the maximum possible level of equivalence to achieve this goal, without violating the norms the language of translation [3, p. 78].

According to H. J. Vermeer, equivalence is a special case of adequacy [8, p. 224]. A. Shveitser distinguishes four levels of equivalence in the model of translation equivalence: pragmatic, semantic and syntactic [6].

V. N. Komissarov suggests five levels of equivalence: purposes of communication; way to describe the situation; description of the situation; structure of expression; lexical and semantic correspondence [4]. E. Nida proposed to distinguish two types of translation equivalence: formal and dynamic [7, p. 53].

V. S. Vinogradov considers the problem of equivalence depending on the type of translated text. The level of equivalence of oral and written translated texts is different. The most difficult in achieving equivalence is simultaneous translation [2].

As soon as the main purpose of translation is to achieve adequacy, the main task of the translator is to skillfully lead various translation transformations in order for the translated text to convey as accurately as possible all the information contained in the original text.

Transformation is the basis of most translation techniques, which implies changing the formal (lexical or grammatical transformations) or semantic (semantic transformations) components of the source text while preserving the information intended for transmission.

We make the conclusion that equivalence and adequacy are interpreted in various ways by translation theorists, and function in translations by their own specific laws.

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## THE ANALYSIS OF TRANSLATION OF TERMS IN DIPLOMACY

Translation in the field of diplomacy has its own rules and features. Diplomatic terminology of the English language is a complex and well-structured system of terminological units.

According to V. Koptilov, the translation of complex terms consists of two main stages: analytical and synthetic. The analytical stage is important while translating phrases – it equals to the translation of its individual components. And for this it is necessary to correctly define the components of a complex term, because they can be not only words but also phrases that are part of a complex term [4, p. 85].

The main stages of translation of a term are as following: clarification of its meaning, which first of all requires understanding of the context, and translation of this meaning into the target language.

There is an opinion that the term should be translated by a term, full and absolute equivalent and therefore, as S. Vlahov defines it, the term refers to units that do not create difficulties in translation [1, p. 274]. However, finding this equivalent results in a very high difficulty, and frequently it does not exist.

N. Katsyshyn differentiates such groups of terms and other language units that may cause some difficulties while translating into the Ukrainian language:

- terms that have two synonymous translation options: **ratification** – *ратифікація, або підтвердження* [2];



- abbreviations, acronyms, initial abbreviations, which must first be deciphered. They convey geographical names, names of geopolitical organizations, political parties, and others. These terms are relatively context-free and often their equivalents can be found in dictionaries, but in their absence, they are transcribed or transliterated: **UNESCO** – ЮНЕСКО;
- false friends of the translator: **protocol** – *правила дипломатичного етикету* [2];
- polysemantic terms: **Party** – *сторона / уряд країни, що підписує документ* [2];
- latinisms as part of a terminological expression are also of interest to translators: **meeting in camera** – *засідання при закритих дверях, таємне засідання*; **status quo** – *статус кво, існуючий фактичний чи правовий стан* [3].

The translation methods of diplomatic terms might be as following:

- translation using the established equivalent: **note of understanding** – *меморандум про домовленість*;
- transliteration: **congressman** – *конгрессмен*;
- transcription: **impeachment** – *імпічмент*;
- descriptive translation: **concordat** – *договір між папою і керівництвом держави* [2].

In conclusion, it is necessary to emphasize that translation of the language of diplomacy is a complicated process which requires the thorough knowledge of its peculiarities.

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## **ANALYSIS OF CARICATURES OF POLITICAL, SOCIAL AND CULTURAL CHARACTER IN THE CANADIAN BILLINGUALISM**

The language of politicians is often quite regulated and traditionally full of misinformation. Therefore, a more objective assessment of the political and social situation in the country is reflected in the mass media. So, we would like to look a little more specifically at the topic of official bilingualism in Canada on the example of cartoons. To do this, we researched cartoons from various Canadian print and online publications. This topic was quite popular in the Canadian media a few years ago, when the question of Quebec's independence was raised. Thus, there are frequent images of stories in the cartoons related to the Quebec issue [1].

One of them shows a freight train carrying a closed container from which someone's dissatisfied eyes look. The container is labeled in capital letters: "bilingualism", and next to it is marked "get to sender" (return to the sender), direction "east" (east). This is a direct reference to Quebec's policy of promoting bilingualism throughout Canada. It is clear that this caricature was executed by opponents of such a policy. Also, the rejection of French as Canada's second foreign language and the desire to get rid of this problem, along with its cause, is shown in another picture. It shows a map of Canada with the province separated and the inscription: "Wow know, this doesn't look so bad ..." (you know, and it doesn't look so bad). The Quebec bloc is often accused of

double standards and hypocritical policies. This was also reflected in caricatures in the media. For example, in the press we can come across a stereotypical representative of an English-speaking Canadian, who came to the office of Quebec Bloc leader Gilles Dussep. Such a cartoon is a parody of the symbol of Quebec - a white lily in the form of a half-peeled banana. This humorous caricature conveys both the simplicity and short-sightedness of a typical English-speaking Conservative Canadian, and the cunning and outright hypocrisy of Dussep's policies. Some cartoons support the theme of the previous one and also point at the openness and double standards of Quebec policy [4, p.132 – 135].

So we gradually move on to cartoons, indicating the existence and inexpediency of disputes over the language issue. Pierre Trudeau Act of Official Languages required French for government employees and institutions, and special training courses were introduced. Workers had to take tests, and this was not overlooked by the authors of the sharply social ironic cartoons, for example, some pictures show an annoyed man forced to take a French test. In addition, to obtain a high public office knowledge of French is simply necessary. The factor of bilingualism is almost crucial for the post of Prime Minister of Canada. Bilingualism appeared in schools where the child speaks only a second language. Of course, this innovation is quite controversial, many consider it superfluous. There are many cartoons which illustrate Anglophone parents. For example, in one of them we can see something like a social poster asking: is French immersion right for my child? (Is "French immersion" appropriate for my child?) This again indicates that such a question is relevant to modern Canadian families. Another caricature, made in the style of a mini-comic, also considers a similar

situation in the family, when the question arises to which school you should send the child, depicting a conversation between father and mother about their son's further education: - Immersion program. But we need to apply now. - Are you sure French immersion is right for him? (Do you really think he needs a "French dive"? ) - Don't want your son to be Prime Minister? (Don't you want your son to be prime minister?) Honest answer? (To tell the truth?) So, the question at the end of the dialogue remains open so that everyone can come up with an answer on their own. However, the irony of this issue is very transparent, some English-speaking parents do not consider it necessary to force children to learn French for the illusory opportunity in the distant future to occupy these children a high political position. In general, such a bilingual situation in the country has raised a lot of questions, but there are also positive aspects in this policy. And they are much more important. Because everyone knows from school the words of Johann Wolfgang von Goethe: "As many languages as you know, so many times you are human [2, p. 260 –271].

Of course, we can speak about bilingualism at the household level. The use of bilingualism at the household level is also illustrated by a caricature that depicts a conversation between a man and a woman over breakfast (Just one egg? That is all you want to eat for breakfast? (Just one egg?) Is that all you want for breakfast?) Well, Sophie, you know what they say in French - one egg is "un oeuf". (Sophie, you know what French is spoken - one egg is "in oeuf"). There are words: un oeuf (egg) consonant with the English enough (enough). Thus the phrase of a man sounds like "one egg game is enough". Knowledge of two languages leads to a certain language mixing. The speaker achieves

a good level of proficiency in both languages and sometimes may not have time to switch language registers during the speech process. In general, this is what Pierre Eliot Trudeau aspired to in his Act of Official Languages. He wanted French to come into use no matter what province people lived in. He wanted the equality of absolutely all Canadians [5].

Thus, after analyzing the texts of the caricatures on the issue of bilingualism in Canada, we came to the conclusion that this problem is still quite relevant. It is observed in all levels of life: from domestic to high politics. The French-immersion program, aimed at ensuring that children from English-speaking environment go to school, where they fall into a fully French-speaking environment, and thus quickly and fully learn French. Such an approach will improve the situation with bilingualism in the country in a few years, but it may be quite traumatic for some families. Therefore, a certain ambivalent component is still observed in the issue of official bilingualism. And it is the mutual compromise of the people of Canada that has significantly reduced the conflicts in this field and what characterizes the current relationship between the word, the English-speaking and French-speaking population of Canada [3].

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## **CRITICAL THINKING AS A CORE OF PHILOSOPHY FOR CHILDREN**

Critical thinking is the most important skill in our uncertain, unpredictable and complicated world. Process of living is accelerating: we need to think faster, solve problems of new being, analyze some information per second and decide what to do in a new circumstances. When we don't have much time to look through and make decisions, our thinking is the one that help us to stay on our feet. To cope with these life challenges our thinking should be critically directed. It comes natural for our society to think that prevalent quantity of skills and abilities is needed for adult life-being, including critical thinking. As a result of this point of view – confused and even lost generation of young adult, which doesn't know what to do in this world or what they want at all. To avoid it, we need to teach children soft skills: communication, teamwork, adaptability, problem solving, critical thinking, conflict resolution, leadership. All of this features piece together in a Matthew Lipman's concept 'community of inquiry' in his Philosophy for Children program, that based on critical thinking ability. To discover the phenomenon of critical thinking in philosophy for children, it is necessary for us to answer three questions: What is the origin of critical thinking area?, What is the essence of critical thinking?, How critical thinking works?

The first step in discovering the phenomenon of critical thinking in philosophy for children is to clearly understand the background of this concept. We need to know what is the person, that one, who act.

This way of thinking has been elaborated by Socrates. According to his approach, discussion about philosophical items is always an ultimately conversation about people's virtues, their subjectivity. The principles of subjectivism have been further developed by Plato, R. Descartes contends that ideas of doubt as a source for thinking is a main way of being, G. Berkley claims that the person perceives the world and determines what is exist [1], I. Kant asserts that mind-feeling unity is an approach of comprehension, J. Fichte highlights the importance of I-absolute as a creating actor, E. Husserl declares that reflection is a significant way of experience obtaining. These ideas come to Ch. Peirce's pragmatism, in which success is related to experience, the last one is always personal and cannot be generalized, but in our unstable world we cannot rely on it, so, belief is a primary source of discovering the world. Critical thinking based on belief, which is connected with doubts, and then it combines with our feeling or interests. The next level of thinking is John Dewey's perception that all of notions, which people use, are means and instruments, that help us in practical activities and constitute our experience. For him, critical thinking is a problem-solving approach. When we talk about psychology views, it's necessary to say, that criticality is a mental ability to understand our mistakes, evaluate our thoughts and analyze social processes [6]. Also need to act with awareness and correct some actions according to reality conditions [2]. Therefore, criticality is a prerequisite for the appearance of critical thinking. Psychologist E. de Bono describes critical thinking as an ability to analyze non-standard situation, using different arguments. Jungian analyst R. Johnson point out, that critical thinking is a special mental process, which allowing to put forward own statement to the proposed



standpoint or behavior model [3].

A second important part of understanding the phenomenon of critical thinking in philosophy for children is exploring the essence of it. The idea of developing critical thinking in philosophy was conceived in the United States about half a century ago. Courses of teaching critical thinking have been established and are operating in some universities. It is possible as a result of Matthew Lipman's efforts, who is a Columbian philosopher and educator, author and developer of the program 'Philosophy for Children'. Lipman's claim that learning activities at the school focused on in-depth investigation of sense sphere and main features of phenomena [5]. Thinking in this case is a part of exploring the world. It needs to be logic and reasoning, that correlate with critical aspect of thinking. So, critical thinking, according to M. Lipman, is an ability to ask new questions, to put forward the diversity of arguments and to make decision independently. Ukrainian researcher S. Terno works in a similar direction and also devise a critical thinking field. He picked out some main component of it, which are mindfulness, autonomy, reflexivity, purposefulness, reasonableness, ability to control and self-organization [7]. American professor D. Klooster developed own structure of critical thinking. He agrees, that autonomy is the main aspect, because when we think we always do it internally, it's personal process. Second important statement – information is a starting point of the critical thinking, which helps us to choose the best way of understanding and generate our own knowledge. Critical thinking begins with intention to find some problems we need to solve; people are curious, so, when they see something new, they want to know, what is it. Also, critical thinking tends to strong argumentation, connection of

cause and effect is necessary. Furthermore, critical thinking is a social phenomenon. During the discussion we can polish up our thoughts, correct it or even change [4].

Finally, a way must be found to embody the practical features of 'doing philosophy' concept and understand, how critical thinking works. M. Lipman is among those, who realize it and helps people to figure out what is going on, how act in different or even unknown cases, express their opinion and interpret information. A lot of adults come to him, asking for help, so, he assumes, that we need to teach children critical thinking in order to make their life-being easier. It was a time, when priority was given to the view, that abstract thinking too complicated for children, it sounds strange, but abstract statements were considered as a harmful for their mind [8]. M. Lipman cast doubt on previous research in the field and proposed an approach, called 'community of inquiry', that contend the value of a teamwork. I agree, that work in small group is more effective (team members act as a researchers), than competitive interaction in the interplay, when one of them can win. Moreover, group interaction allows children to ask a question about the essence of the objects, what is similar to philosophers' language. Thus, M. Lipman suggests the triple model of thinking: critical + creative + value-based (emotions and feelings). In addition, it's necessary to mention three ways of learning something: slow reading, asking a question and discussing [8]. These ideas are developing by S. Terno in technique of critical thinking, which based on teaching history. Children during a lesson have some cases and look for causes and effects of historic occasion, discover some facts and distinct it from opinion, verify arguments and pinpoint logic errors. Therefore, we can say, that all of

these activities help children to develop the reflexivity and other features of critical thinking.

According to ideas, mentioned above, we can conclude, that critical thinking is the most significant skill in our life and important part of children training. To sum up, it is worth noting that idea of critical thinking is emerging in an ancient Greece (Socrates, Plato and their followers), developing in a modern time (R. Descartes) and take shape in I. Kant doctrine. For many philosophers and psychologists critical thinking are problem-solving approach and mental ability. Exploring the features of community of inquiry concept, I argue, that there is reflexivity space of mindfulness, autonomy, targeting, argumentation, controllability and self-organization. Teamwork in a small group is the best opportunity to investigate the essence of the things and discuss about it. All of these ideas can develop our mind and teach us critical thinking.

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## **THE ROLE OF BILINGUALISM IN THE POLITICAL SYSTEM OF CANADA**

Canada is a democratic state and a constitutional monarchy with two official languages and two legal systems - civil law and common law. Canada is a federation consisting of ten provinces with a system of almost complete self-government and three special territories under the direct control of the central government. The head of the state is the Queen of Canada, she is the Queen of Great Britain, Australia and New Zealand and other countries scattered around the world - from the Bahamas to Papua New Guinea. Each law is approved by the government on behalf of the Queen, but the authority to enforce the laws is given to the officials on behalf of the Canadian people [1].

In the current context, Canada is a federation of ten provinces, which together with the three territories form the world's second largest country. The administrative-territorial division of Canada is formed by 10 provinces (Ontario, Quebec, Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island, Manitoba, Saskatchewan, Alberta, British Columbia) and three territories (Yukon, Nunavut and North) [4, p. 27].

The real power belongs to the parliament, which performs the legislative and executive functions and consists of the monarch of Great Britain, the Senate and the House of Commons. The British monarch in

Canada is represented on a permanent basis by the Governor-General, who has been symbolically appointed by the monarch from Canadian citizens on the recommendation of the Prime Minister of Canada. O.I. Maksimova looked in detail at the system of public administration in Canada. First of all, the author analyzed the management of the country at the level of administrative-territorial units. The Canadian Federal Parliament consists of two chambers: the House of Commons and the Senate. It also includes the Governor-General, who represents the Queen. The House of Commons, whose members are elected by the people, plays a leading role, and the Senate, whose members are appointed on the recommendation of the Prime Minister, offers alternative "sober opinions" on laws. Both chambers have the right of legislative initiative, but the Senate cannot introduce bills on public financial expenses or taxation. The Prime Minister and the Cabinet (Government) are always members of the political party that has the majority of seats in the House of Commons. Senators may also be Members of the Cabinet. Usually the Head of Government in the Senate is appointed to the Government. Other Senators can also be members of the government, if their provinces are not represented in the Cabinet [4, p. 27-28].

We would like to emphasize the Canadian party system. Today, the Senate is represented by two leading parties - the Conservative Party of Canada (Conservative Party of Canada) and the Liberal Party of Canada (Liberal Party of Canada). The House of Commons also includes members of three parties: the Quebec Bloc, the Green Party and the New Democratic Party.

Thus, we can now compare the structure of the Government of Canada and the practical functioning of official bilingualism at the governmental level. French and English have been the official languages of the Canadian Parliament since 1867, but only a few members of Parliament have ever been able to hold a full discussion in their second, non-native language. Simultaneous translation was used only in 1960. Until then, the debate in parliament was conducted by two separate groups, which discussed issues in two different languages. This significantly slowed down the legislative process. In addition, the language of the administration before the Act of Official Languages of 1969 was exclusively English [5, p. 134]. Good command of English was a prerequisite for becoming a prime minister, as the majority of any parliamentary faction large enough to form a government always consisted of Anglophones, not to mention the electorate. However, not being able to speak French was not always considered a sufficient reason in order not to obtain the post of Prime Minister. All English-speaking Canadian prime ministers had in their cabinet ministers who were responsible for Quebec's provincial interests and spoke French [5, p. 134].

But since 1982 the prime minister and party leaders have been required to be bilingual. An important factor in this trend has been the TV debates between party leaders, which are conducted separately in English and French. The parties consider it necessary to have a leader who can at least take part in both debates, even if he cannot win both of them. The need to speak both languages is a symbol of Canadian identity as a linguistic duality, and also has a practical political purpose,

as the Prime Minister is the leader of a federal camp that opposes Quebec separatism and has to have opportunity to fight for the “hearts and minds” of Quebecers in their native language [4, p.67].

The Government of Canada website [2] lists Canadian prime ministers according to their native language. As we can see, English is much more prevalent in the language of politicians. For most, it is their mother tongue and the language of the environment in which they live. Thus, there were fourteen Anglophone prime ministers in all, while French was the native language of only six out of seventeen. Of the Anglophones, only five speak French at an intermediate level sufficient to understand and get engaged in simple dialogues and speeches, and only three of them are fluent in French, can communicate fluently, understand it and debate at the appropriate level. Two representatives of the Canadian prime ministers, Mackenzie King and John Diefenbaker, did not speak French at all. Among the Francophone prime ministers, only two spoke English slightly worse than their own, Wilfrid Laurier and Jean Chrétien. Thus, we can see that out of all the Prime Ministers of Canada, fourteen out of seventeen were bilingual. Among them you can see full bilinguals, who from childhood grew up in a bilingual environment and equally mastered both English and French. These are well-known politicians such as Louis St. Laurent, author of the Act of Official Languages Pierre Elliott Trudeau, Brian Mulroney and son of Pierre Trudeau. Justin Trudeau is the current Prime Minister of Canada. Three of these people belong to the Liberal Party and one to the Progressive Conservative [3]. The inability of the leaders of some smaller parties to speak French, and thus to fight for the electorate in

Quebec, is one of the most important reasons that these parties cannot compete with conservatives and liberals.

So, we can say that the ruling elite of Canada is really mostly English-speaking. At the same time, politicians who do not target the positions of party leaders or the prime minister often do not consider it necessary to teach or improve a second language. This is especially true of politicians that speak English. But we can say that French speaking politicians are quite fluent at their second non-native official language.

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## **METHODOLOGICAL BASIS OF INTERNATIONAL ENVIRONMENTAL LAW RESEARCHES**

Proper development of methodology is a common problem to any branch of law, especially international environmental law. Methodology can take various forms, but it comes down to the systematic procedure that a scientist uses as part of intellectual cognition. Based on the study of Steven R. Ratner and Anne-Marie Slaughter, six methodological concepts inherent in modern international environmental law can be identified:

1) Positivism summarizes a range of theories that focus upon describing the law as it is, backed up by effective sanctions, with reference to formal criteria, independently of moral or ethical considerations.

2) Policy-oriented jurisprudence describes itself as a policy-oriented perspective, viewing international law as a process of decision making by which various actors in the world community clarify and implement their common interests in accordance with their expectations of appropriate processes and of effectiveness in controlling behavior.

3) International legal process considers the key role of law in constraining decision makers and affecting the course of international affairs.

4) Critical legal studies. Critical legal studies scholars have sought to move beyond what constitutes law, or the relevance of law to policy, to focus on the contradictions, hypocrisies and failings of international legal discourse.

5) International law and international relations is a purposefully

interdisciplinary approach that seeks to incorporate into international law the insights of international relations theory regarding the behavior of international actors.

6) Law and economics have both a descriptive component that seeks to explain existing rules as reflecting the most economically efficient outcome, and a normative component that evaluates proposed changes in the law and urges adoption of those that maximize wealth [1].

Addressing domestic scientific works, O. Kyivets tried to offer her own approach to cognition of the basic categories of international law. She distinguishes the classical formal and legal philosophy. The formal approach is mainly the result of the positivist tradition of understanding of law. Legal philosophy is based mainly on the natural and legal comprehension of sources of international law and allows us to analyze not only the form of existence of the sources, but also their axiological content, which is outside the form of the source consolidation [2].

Thus, the list is only an attempt to highlight the basic concepts of international environmental law which dominate today. In general, it is not possible to single out one of these methodological approaches for the study as the only correct one. Because each of them allows researchers to create their own versions of solutions of methodological problems and contributes to the deepening and development of legal thought in the field of methodology.

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## EUROPEAN STRATEGY

The start of the new historical dynamics that would eventually open the way for the 2003 European Security Strategy may perhaps best be placed in the mid-1980s: a time of painful European-US tensions over the management both of East-West relations and of out-of-area threats (including, significantly, terrorism). Enlargement made the EU more 'representative' of all European states and of Europe's various strategic sub-regions, while bringing in useful new strategic resources.

All these trends shifted the balance of threats to security, and of the methods needed to maintain security, in Europe towards the end of the spectrum where the EU was at home: while also calling for greater European self-awareness and self-reliance. They were coupled with internal EU dynamics that pushed in the direction of a steady increase in ambition and the enhanced institutionalization (or at least coordination) of different dimensions of governance, including some that the founding fathers had never dreamed of bringing into the Community process.

In retrospect, innovations that helped to set the scene for the defence and strategic developments of 1999 onwards were: (a) the creation of a new, third pillar dealing with internal security, and its relatively rapid assimilation into the 1957 Treaty of Rome mainstream; and (b) the formulae of the 1992 Treaty on European Union (Maastricht Treaty) and the 1997 Amsterdam Treaty, which for the first time envisaged the use of military resources for EU policy aims, albeit at this stage *via* the Western European Union (WEU). Taken together, these

showed that the EU not only had a growing appetite to act in traditional 'power' dimensions but also was capable of finding the institutional fixes required, case by case and beyond the confines of traditional 'treaty method'.

At the end of the 1990s, the Balkan wars, which had in the early part of the decade done so much to underline the weaknesses of the CESP, gave the decisive boost to the creation of the Common European Security and Defence Policy (CESDP, later usually referred to as ESDP). The Kosovo crisis crystallized the frustration of the EU's largest military spenders, France and the United Kingdom, with Europe's poor capabilities performance overall. But it also created European – US tension over questions of *method* and *control* in Western crisis management, leading even the UK to express the view that Europe must have at least the option of operating under its own flag in the future.

Some curious foreshadowing of the events surrounding the 2003 EU may be seen: (a) in the fact that the crucial steps to launch the CESDP were taken while most EU members were still fighting side by side with the USA in Kosovo, and (b) in how quickly the institutional Gordian knots were cut through once the political will was there (*vide* the abrupt jettisoning of the WEU). There was also a new flavor in the way that the EU members pushed through their new policy, shouldering aside, for instance, the non-European allies, which lost at a stroke the advantages they had enjoyed in the WEU framework. At the same time, the way in which the CESDP was first set up created a 'conceptual gap' calling for further work on strategy, because the initial emphasis was so much on capacities and on generic types of operation rather than on

policy goals and rationales. In the atmosphere of the time, there was a strong and persuasive flow of opinion in favour of the EU's 'learning on the job' without too much theorizing.

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## **CHRISTIANITY AND ISLAM IN UKRAINIAN HISTORIOGRAPHY - RELIGIOUS RECEPTION STUDIES PERSPECTIVE**

In traditional Ukrainian historiography and mass consciousness, the history of Ukraine is inextricably linked with the Orthodox faith. Many scholars noted the religious component as the leading one in the development of Ukrainian-Turkish relations on Southern Ukrainian frontier, relations between Ukrainians and Tatars, Polish-Ukrainian relations, in particular the war that has a name Liberation War of the Ukrainian people in the middle of the seventeenth century, etc. Taking into account these circumstances, many researchers emphasized the constant conflict between Cossacks and Tatars, highlighting a religious issue as a basis of antagonistic relations. From scientific works such views transferred into public opinion. As a result, the concept of righteous Christian Cossacks – knights, defenders of Orthodox faith and Orthodox population from «evil busurmans» has a notable presence in modern Ukrainian society.

Naturally, for contemporary scholars, it looks dubious to give the major attention to religious factor in relations mentioned above. The tendency to demonize the Tatars and to glorify Cossack's Christian moral virtues is controversial as well, especially considering that methods of interaction on both sides of the frontier were practically the same [1]. The question «How much does the idea of Cossacks as true Christian knights correspond to reality and what was the role of

Orthodox faith in the life of average Cossack individual?» also deserves and starts to receive further attention. Taking into account that problems of religious nature played an important role in large number of conflicts in the mentioned area indeed, the further research of religion reception is an issue with high relevance.

However, while recent Ukrainian historiography has abandoned this concept, and scholars understand Southern Ukrainian steppe frontier as a diverse region and

have less bias towards both cultures, the myth created by several generations of imperial and soviet era studies is still strong in mass consciousness. Thus, it is important to search for new ways to popularize research results in order to change public opinion on the subject.

Furthermore, religion often becomes an instrument for political manipulations. One may see this issue in the concepts like «The Russian World» or «The Moscow as the Third Rome» used by the Russian Federation for ideological justification of authoritarian and expansive policy. These issues become even more relevant with relatively recent attempts of the Russian Orthodox Church to prevent the Ukrainian Orthodox Church from obtaining its own autocephaly.

Thus, studies on religious reception are extremely important in the context of Ukrainian history: they assist in the exploration of Ukrainian mentality origins, polyethnic and multi-religious relations in the region, provide a valid context to the events that took place in the twentieth and twenty-first centuries in Ukraine and Eastern Europe in general. Besides, the proper study of religion in our past is an essential component in dispelling historical myths and resisting attempts to

manipulate our minds. Further researches of religious receptions have a lot of potential in broadening our understanding of the role of religion in history.

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## **GENRE OF CREEPYPASTA IN MODERN DIGITAL MEDIA ENVIRONMENT**

The word «creepypasta» appeared in 2007, when it began to be used on the imageboard 4chan. The term emerged from the combination of the words «coppypasta» and the adjective «creepy». At first, creepypastas were gothic and horror content, which had the viral potential of coppypastas. These were mainly diverse images and stories inspired by urban legends. In the framework of modern research, creepypasta is understood as the genre of the digital environment, which is based on the story with horror elements, intended for distribution on the Internet.

Most modern approaches to the consideration of creepypasta include folklore analysis of the distribution and variation of works. On the one hand, creepypastas are difficult to associate with definitions of folklore, which is characterized by its sources in folk culture. On the other hand, some researchers believe that creepypasta continues folklore traditions. The medievalist Bruce McClelland thinks that one of the characteristics of folklore is communicative behavior which does not belong to an individual or group and is transmitted spontaneously, from one individual (or group of individuals) to another [1]. This thesis coincides with the root characteristic of a creepypasta – the ability to spread from a resource to a resource. Researcher Christy Williams considers creepypasta a digital version of folklore, because most of works have a basic story that is constantly retold and transformed, giving rise to new options, like ordinary folklore [3].

Despite the observations that creepypastas are the product of the work of the Internet community, in modern academic studies there is a peculiar lack of connection between digital fiction and creepypastas. Although there is a large degree of similarity between them. Digital fiction is defined as fiction that is created for computer screens (and read on them), reaches its verbal, discursive and conceptual complexity due to digital media, and will also lose something from its aesthetic and semiotic function if it is removed from this medium. These features directly define creepypastas, because the representation of story outside the digital medium limits it in the possibilities of potential interaction or distribution. Often, a significant part of narratives is implemented cross-media, covering not only platforms for publishing text, but also video hosting and other types of resources. Each platform primarily presents a set of tools for the development of story and its realism, so that creepypastas easily change their discursive features between platforms, smoothly integrating into the flows of publications of real people – creepypasts on a certain platform will adhere to the conventions and rules of this platform.

A significant contribution to the development of the creepypasta phenomenon was made by the *r/nosleep* – community of creepypasta authors and readers on Reddit. The game's own rules have turned horror stories into a unique communicative phenomenon. Creepypasta on Reddit is characterized by going beyond the traditional communicative model. The key elements in communication (except for the message itself) are the source, channel and recipient – these components were allocated in the first Harold Lasswell model. Creepypasta transforms the relationship between the author and the reader – these roles

become conventional, since the functions of the first partially switch to the audience. This feature, in general, is characteristic not only for creepypastas, since, according to Limor Shifman, in case of genres in the digital environment, the community generating content acts as its consumer and interpreter [2]. On the other hand, creepypasta not only destroys the traditional ideas about the author, but also warps the plot structure. The classic plot of the work of art presents the reader with an exposition, a tie-up, the development of actions, a climax and a limb. Creepypastas, a significant part of which are serial works, stop at the climax, giving the audience the opportunity to influence further events in story. These features are successfully implemented on subreddit r/nosleep due to well-defined rules. They include a requirement for the originality and plausibility of the story, the need for a plot, certain requirements for headlines. A separate rule requiring explanation is «Everything is true here, even if it's not». The idea is that the story that the author tells should be perceived by users as happening to characters in reality. Sometimes the personality of the author merges with the personality of the main character of the story – and this is how he is perceived by users who write comments, addressing them primarily to the main character. At the same time, among the comments you can see words of support and sympathy, as well as certain advice or thoughts of the audience, how the character should behave in the future.

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## **Секція 3**

*Сучасні дослідження в сфері  
соціально-економічних наук та  
інформаційних технологій*

## **THE IMPACT OF THE PANDEMIC ON THE GLOBAL ECONOMY**

Coronavirus has affected many areas of society. In particular, the pandemic has caused an economic crisis in all regions of the world. Every viral disease that spreads at such a rate requires the introduction of special measures. The situation with the coronavirus required: closing country borders; isolating people where they live; going outdoors only if necessary (buying food, medicine) closing education institutions, public places; limiting travel by public transport; disinfecting streets, public transport; checking the temperature before entering buildings, remote work, curfews. It is different in all countries, depending on how fast the disease is spreading. The pandemic dictates its conditions for survival, so governments are forced to spend billions of dollars to provide hospitals with everything they need, and to invest in medical laboratories to speed up vaccine development. This is the first time in 75 years that the world has seen such a global economic downturn just of the impact of COVID-19.

Because of the mass stricken disease, factories are forced to suspend operations. Unemployment and global poverty have risen significantly. Some businessmen have forced workers to resign at will or go on unpaid leave. According to the ILO, job cuts have reduced the income of workers by \$3.5 trillion, i.e. 5.5% of global GDP. Therefore, the government is introducing social benefits, lowering taxes and giving low-interest loans to support businesses, households and unemployed people. In total, since March 2020, these expenditures amount to \$12

trillion. But it has not stopped the national economies from falling, as travel and export-import processes have been undermined. Analysts argue that economic recovery is realistic with adequate quarantine restrictions and government support for businesses.

According to IMF estimates, global GDP fell by 4.4% under quarantine, in the Eurozone by 8.3%, Italy by 10.6%, Spain by 12.8%, France by 9.8%, Great Britain by 9%, Germany by 6%, Brazil by 5.8%, Ukraine by 7.2%, the USA by 4.3%, India by 10.3%, Japan by 5, 3% and Russia by 4%. China is has been already recovering. Its economy has grown by 4,9% in Q3 2020 compared to the same period of the previous year. It is significantly below forecasts but, compared to the previous decline, the change is significant. China is the first economy to show growth after the epidemic and it is leading the global recovery of the world economy. Rosamund Hatta for the WEF has analyzed the impact of the coronavirus on the global economy so that we can summarise her findings:

- Decline in growth rates of advanced economies;
- decline in the indexes of stock exchanges in the Americas, Europe, Asia-Pacific;
- decline in demand and oil prices;
- a slowdown in the metals market (down 7.1% in January 2020);
- shortage of components from China, which form the basis for products of well-known brands (Apple, Toyota, General Motors, Hyundai, etc.);
- declining revenues for companies in the air and maritime transport sectors (Q1 2020: airlines lost \$4-5bn, maritime up to \$4bn);
- decrease in incomes of the population;
- a crisis in the tourism sector, hotel and restaurant services;

- increase in sales of medical equipment, medicines, hygiene products and disinfectants;
- the growth of the online application industry (educational, gaming) over \$150 billion;
- decline in the profitability of advertising on Google and Facebook;
- increase in demand for less risky assets;
- government securities, gold;
- reduction of nitrogen dioxide in the air by 36% compared to 2019.

Pfizer says it will be able to produce 50 million doses this year to protect 25 million people. So 13 billion doses of vaccine will be made in 2021, which, relative to the world's population, is not enough. The head of UBS said that even with the vaccine, the economy takes time to recover. It will take at least a year to get GDP back to pre-crisis levels and it will take twice as long to rehabilitate the unemployment rate.

The coronavirus pandemic caused a global collapse of economies and proved that even the advanced countries were not prepared for such a situation. The service, tourism, transport and hospitality sectors suffered the most. Oil has fallen in value in just the last 30 years. The biggest beneficiaries were pharmaceutical companies, medical device manufacturers, the online application industry and online shops. A recovery in air quality is also positive. Therefore, the quarantine was an occasion to review and improve the weaknesses of countries' economies to sustainably withstand such situations in the future.

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## **THE IMPACT OF THE PANDEMIC ON SMALL BUSINESS**

COVID-19 has negatively affected not only small enterprises but all areas of business. Examples include falling oil prices, declining revenues for airlines, shipping, and the tourism industry.

Small business is an independent economic activity that has any form of ownership and it is the basis for the state economy. A person who is or wants to be an owner of a small enterprise has to take full responsibility for providing jobs, creating the appropriate working conditions for employees and high-tech equipment, as well as for all financial payments. The purpose of this form of business is to make a profit and self-realization. The advantages of small business over the large business are a rapid adaptation to market conditions, economic and political changes. Countries are trying to develop this area of activity to improve the current economic situation, create a competitive market environment, effectively meet the diverse needs of consumers [2].

Since December 2019, the world has been under the threat of the COVID-19 pandemic, which has made its negative adjustments to the Ukrainian market too. As restaurants, shopping malls, and shops were closed, people lost the opportunity to work and grow their businesses. According to the Union of Ukrainian Entrepreneurs, about 6% of small business entities closed in March 2020, causing losses to the state. The negative trends prevail in the world economy. The owners

are cutting jobs, the development of enterprises is slowing down, the purchasing power of the population is falling rapidly. It is crucially important that the models for the survival of small-scale industries have to be improved because the management methods, rules and regulations, which operated until 2020, no longer allow to make a profit and ensure development. Imports and exports have declined because 80% of borders are closed. Consequently, small entrepreneurs do not have the financial or physical ability to receive imported goods and services [1].

In 2020, entrepreneurs were offered new market rules. Obviously, in these economic conditions, every owner needs to adapt the business to new conditions and restrictions, elaborate effective strategies and look for new financial opportunities in order not only to recoup costs but also make an economic profit. In these circumstances, the government has to provide benefits or assistance to small business.

A positive example is the experience of Germany. During the quarantine from March to May 2020, the state reimbursed small and medium-sized businesses 10 thousand euros to prevent bankruptcy. This support has shown that the government cares about small business and takes measures to improve the socio-economic situation. In autumn, during the second wave of the pandemic, Germany reimbursed 75% of monthly earnings to all enterprises employing less than 50 workers and the self-employed.

Ukraine has capabilities and resources to ensure the minimum costs of small, micro and medium-sized businesses. However, this requires combating corruption and unfair treatment of outsiders. Tax and customs reforms are necessary to increase the transparency and accountability of these bodies. Ukraine's energy sector reform is also es-

sential because energy is the basis for national security and economic growth.

Medical reform is long overdue since the new measures will provide citizens with equal access to quality medical services and change the system so that the patient is at the centre of this system. Medical reforming must also ensure affordable health care and guaranty its quality.

Having analyzed this problem, we can infer that due to the pandemic small business is losing their economic capacity and advantages in the market. Research in this area has a scientific perspective.

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## **FEATURES OF STEREOTYPE PERCEPTION OF DOMESTIC AND FOREIGN BRANDS**

The problem of forming a positive vision of the brands of a Ukrainian manufacturer by the state, as well as maintaining the brand of the state itself, is extremely relevant in modern Ukraine. In the context of the political and economic formation of the state, the political orientation of the government to support the Ukrainian economy and import substitution, there is an urgent need to create a strong position of domestic brands in the market of goods and services. Stereotypes play an important role in shaping our knowledge of the world around us. The specificity of stereotypes lies in the fact that an individual has a certain position based on life experience and on the peculiarities of his social environment, and thanks to them, often, a person has certain patterns of behavior. Determination of the brand aspects which are the factors in consumer choice in the market, which of them are evaluated by consumers as “good”, etc., which, in turn, will allow the most efficient development of the Ukrainian brands in order to make them as competitive as possible in the market. The significance and relevance of the study is also due to the fact that, while solving problems in conditions of uncertainty, a person tends to use unconscious heuristics and stereotypes. D. Kahneman wrote about this. However, research in the field of business psychology from the point of view of this position, including brand perception research is not enough.

At the beginning of the twentieth century, publicist U. Lippmann

used the concept of “stereotype” to denote the phenomenon of a similar attitude of people to a certain object or phenomenon on the basis of a common feature inherent in every representative of society. Lippman noted that in the meaning of each person there are “pictures of the world”, certain symbolic combinations that are used by people to explain and simplify information about the world around them.

In modern approaches to the definition of a stereotype, two main contexts have emerged: social and individual. The social context predetermines the understanding of the stereotype as an attribute of social community, unity, identification of a certain society, attention is focused on its social function here. The individual context allows us to consider a stereotype as a mechanism of categorization, simplification and systematization, which makes possible to save human resources while processing information, and gives priority to the cognitive function of this phenomenon.

Considering the concept of “brand”, you can find a huge number of definitions, each of which reflects some particular aspect of this phenomenon. In general, a brand can be defined as an image of a material product or service in the minds of consumers, which helps to identify and differentiate it from other goods, and also stimulates to purchase it. An important part of the brand is also its attributes. Brand attributes are a set of tangible and intangible symbols and forms that help the consumer associate with the brand. The main tasks of attributes are to communicate brand values. Brand attributes include: brand name; brand symbols (trade mark, logo, style); motto / slogan; color scheme; brand mascot; musical and sound accompaniment; accompanying attributes. The brand name is undoubtedly its main attribute. Thanks to

the name, consumers distinguish one brand from a host of others. There are a number of requirements for developing an effective brand name: it should be short and succinct, it should be significantly different from the names of other brands, it should be positively emotionally colored and expressive, it should be easy to read, it should carry the main idea of positioning and carry value to some extent reflecting the lifestyle of consumers, etc. Brand symbols promote brand differentiation, create an identity and evoke associations among consumers. The motto and slogan are essentially a way to convey to the consumer the main advantage of the brand over competitors, as well as the strategy and principles of work. It carries the main advertising information about the brand. The color scheme is used to complement other brand attributes (advertising, logo, packaging) and, with prolonged use, can enhance their effect. The mascot or “living symbol” of the brand embodies the brand’s personality, tries to establish closer contact with the audience and is used in brand advertising constantly. One of the least researched aspects of brand choice is country affiliation and ethnic stereotypes associated with the country of the brand. For example, some studies show that a product is perceived much more positively when not only the brand is recognized, but also the country of origin. Much depends on the country. We all have stereotypes that, for example, clothes from Italy are stylish, fashionable, and clothes made in Asia are considered to be of poor quality.

Thus, it can be assumed that not only the perception of the brand itself, but also the brand of the country of manufacture are being of great importance. A brand, being a “representative” of a country, together with its values and identity, conveys the values and

identities of that country, and can be directly dependent on the brand of the country itself. Thus, consumers in the CIS will prefer products from Europe to products from China, and «Made in China» trademark is no longer considered unacceptable for purchase in the US. Ethnic stereotypes play an important role in the role of the consumer's attitude to products from different countries. This is due to the processes of globalization, tourism, and an increase in consumer awareness. So, having a negative experience with a representative of another country, a consumer can project his stereotype about him on this country, which, in turn, may affect the perception of the brand produced in this country. Accordingly, it can be concluded that consumer stereotypes associated with producer countries are important in shaping brand identity. Such stereotypes can either help or hinder the promotion of brand products in the market.

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## **APPLICATION OF COACHING GAMES IN BUSINESS**

Leaders often need to find non-standard solutions while activity process. Daily affairs and routine lead to difficulties in managerial creativity, causing burnout. In order for inspiration to come, new solutions are to be created, you need to relax, get distracted from the situation that worries.

Speaking about the possibility of using coaching in business, it is necessary to point out its basic principles. The goal of coaching is to drive the client towards changes, therefore, the use of coaching principles provides new opportunities. Man is capable of changes, however, access to information is often blocked by consciousness, and changes (internal, external) do not occur. Consciousness is characterized by doubt, it is regulated by social norms, consciousness is waiting for logical justifications in order to start acting. All this prevents a person from realizing his experience and potential and starting to move towards change. The manager's or employee's awareness of the conditions in which the activity is taking place at the moment, the acceptance of responsibility for their choices, the search for something new in their work, lead to personal transformation.

A. Maslow noted that coaching game uses the idea of subjectivity and responsibility, the value foundations of activity - self-actualization, meanings, love, creativity, freedom, responsibility, autonomy. Transformations in coaching games begin when a psychologist helps



a client to take an author's position in relation to his life, realizing his values. When external obstacles, difficulties, new tasks arise, the structure of the self-actualization can be rebuilt in order to assimilate to new conditions, in this case the value sphere can also absorb new experiences and be corrected. And the more a person includes new experiences in the structure of his self, the greater the change in values, and then the deeper their revaluation.

In the development of coaching games, the ideas of G. Allport and M. Erickson are used to design the situation of changes. The game creates meaningful contact, emotional involvement of the participants, where true motives, goals and values are revealed. Through the actualization of meanings and values, dissociation, resources are released and resistance is reduced. The task of the game is to actualize awareness about the targets and intentions.

The mechanisms of using metaphors that operate in psychological games and fairy tale therapy are based on the free acceptance of rules and voluntary involvement into them, in a context not related to work, benevolence and valuelessness, and positive emotional stress. While the game, the leader receives images, sensations, impressions, new thoughts, this helps the client to see the solution of his problems, live through some processes or overcome some difficulties in achieving goals.

The use of games in business (the method of interpreting metaphors) will reveal either unconscious or non-verbalized states of a person, his style of behavior in a situation that is symbolized by the game. The metaphor model is based on the idea of transferring information, or knowledge, between two conceptual areas: source and

target.

Thus, the use of coaching games in business is a multifunctional tool: it increases imagery, activates human emotions, affects the value-semantic sphere, and not logic. The game situation reduces the level of significance of what is happening, reduces the level of self-censorship. A special role is played by the phenomenon of facilitation, which manifests itself in the course of the transformational coaching game - support, empathy, understanding, attention, unconditional acceptance and tolerance. As a result of such interaction, unconscious abilities and resources of participants are revealed, opened and demonstrated.

Transformation occurs when the principle of the situation is changed. In practice, the leader gets used to looking at the situation (task) as insurmountable. The metaphor demonstrates the point of "pain" where there are not enough resources and strength; allows you to see yourself in the situation better and accept your limitations. Sectors of the playing field, personifying the dynamics of experience in the professional past, helps to characterize the current situation and future goals. Analyzing the metaphorical meanings of their chosen images (landscapes), managers see the content of their activities, realizing the values that they embody.

The coaching game copes with the task of inspiration, moving towards his request - the leader gains faith in the solution of his problem situation, in the implementation of his plans, where the visualizing mechanism works, mentally constructing a model of the life situation that he wants to have. Psychological clamps, social normativity, the desire to be good, successful, correct are removed in the game. At this moment a step forward, a change and an acceptance of a new task take

place. As a result, there are soft changes in the leader's attitudes and new suitable solutions come. In the game, the leader seeks solutions. Due to this, he is involved in his activities. The task that caused fatigue yesterday gives inspiration and energy today. When a leader seeks solutions, he strengthens his sense of belonging to the company. In the game, the leader creates the event, designs it in the game, allows you to develop ownership. He is the author, agent of this event. Then the event (or task) does not descend "from above", when the mechanisms of obligation and coercion are triggered, authorship allows the leader to feel new meanings in his work, to feel "freedom" in activities, to reveal potential of his leadership. By developing his involvement in the company through the game, the leader gains new powers of influence on his subordinate staff.

In the future, a new vision of tasks and the resources opened while the game will allow the manager to implement other techniques and use other developmental mechanisms. The coaching game allows the leader to translate the problem into a task.

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## **IDIOMS IN ECONOMIC AND BUSINESS CONTEXT, THEIR MEANINGS AND ORIGIN**

Over the centuries, a special group of expressions such as phraseological units and idioms has been preserved and formed in the English language. Their correct use makes speech more expressive. Today, in a period of globalization and flourishing international cooperation, the knowledge of business vocabulary of the English language and the features of business communication are extremely necessary both for experts in the field of international economics and for managers of large companies and international enterprises.

To start up, the meaning of word “idiom” should be found.

IDIOM (from the Greek *idios* — ‘own’, ‘peculiar’) is a linguistic term denoting an expression (turn of speech), used as a whole, not subject to further decomposition and usually does not allow the rearrangement of its parts within itself. A characteristic of the idiom is that its meaning is not equal to the meaning of its constituent elements [1].

An idiom is a phrase whose meaning is not determined by the meaning of the words included in it, taken separately. In some cases, the way in which individual words are formed into an idiom is often illogical and grammatically incorrect; sometimes idioms are quite logical and grammatically correct.

One of the most pressing areas that each of us is forced to touch

in the economic sphere is the topic of money: people discuss salaries, take out loans, lend money, invest their savings, etc. Therefore, first of all, we will consider the idioms related to the topic of money. There are some of most interesting examples.

*A white elephant* — something enormously large and expensive, but totally useless.

The meaning of the term goes back to the sacred white elephants of Southeast Asia, which were kept by the monarchs of Burma, Thailand, Laos and Cambodia. Having a white elephant was honourable, it was a symbol of the fact that the monarch ruled the state justly and wisely, which meant that the state was blessed with peace and prosperity.

If the monarch gave someone a white elephant, this was considered a blessing and spoke of the monarch's favour. At the same time, the gift became a curse - it was impossible to give, sell or use an elephant on the farm, and caring for it cost fabulous sums.

In the West, the term "white elephant" was applied to an expensive burden that did not live up to expectations. It was first used in the 1600s and became widespread in the 1800s [2].

Next turn of speech, just like previous, is an animal idiom. This phrase is well-known worldwide and is used quite often.

*To kill the goose that lays the golden eggs* — to destroy something that makes you profit.

This idiom originated from Aesop's Fables, in the tale of a greedy couple killing their goose who laid golden eggs, thinking that they would find more gold inside.

*Golden handcuffs* — increase in salary, which is given so that

the employee does not quit and does not go to competitors.

According to Merriam-Webster Dictionary of Idioms, this collocation dates back to 1976. It was stated by John Steinbeck, who described San Francisco as a «golden handcuff» without a key.

The following idiom is often used in the economic and business sphere:

*To rob Peter to pay Paul* — borrow from one to give to another.

This turn of speech goes back to the custom of the clergy to transfer the church utensils of the rich churches to the poor [3].

The next phraseologism *a Roland for an Oliver*, meaning ‘worthy answer on anything’, goes back to the French medieval epic, whose heroes, Roland and Oliver, were equal in strength, and therefore their rivalry did not end with the victory of either of them. It can be quite useful in describing the current situation between competing companies.

*Penny-wise, pound-foolish* — risks big for small, unwisely disposes of large sums / something will help save now, but will lead to waste in the future [4].

The author of the expression is Robert Burton. For the first time, an English scientist at Oxford University used it in his work “Anatomy of Melancholy” (1621) [5].

Last idiom is not least interest. It has one of most positive meanings of all phrases we have considered.

*To be / live in clover* — prosper, live in luxury, happily ever after.

In fact, the phrase originally sounded like “a cow is / lives in clover”. The fact is that ruminants love clover and prefer it to ordinary grass. In addition, cows feed quickly on clover and do great when they eat it. Therefore, a person who lives happily ever after was compared to

a contented cow grazing in a clover.

Idiomatic expressions are unique to each language. They show the richness of the language, its long history. It is undeniable that knowledge of idioms allows you to better understanding of the context of what is said, the speaker's attitude to the topic, and various nuances. Idioms help deepen knowledge on any topic and economics is no exception. Therefore, it is undoubtedly worth paying attention to familiarizing yourself with them.

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## **HUMAN MIGRATION AS A GLOBAL MODERN PROBLEM**

It should be noted that the problem of migration became global in the late XX - early XXI century, and the growth of the migrating population is growing steadily. The movement of human resources (or migration) is the crossing of a border between two countries by a person or group of people, whether voluntary or coercive, with or without legal grounds.

According to the study conducted in 2019, most migrants who have overcome the difficult path from Africa to Europe could do so again, even if they knew what they would have to go through. According to the survey of 2,000 illegal migrants, 93% were in dangerous situations, but only 2% agreed that they would stay at home. However, it turned out more: 50% of workers said that they did not earn enough and this was the main reason for many to cross the border [1].

If we consider the problem of refugees in Europe, then, of course, it should be noted that the main reason for crossing the border is military action in Syria. We propose to consider UN statistics, which show the number of refugees in the world since the beginning of the war in Syria in 2011.



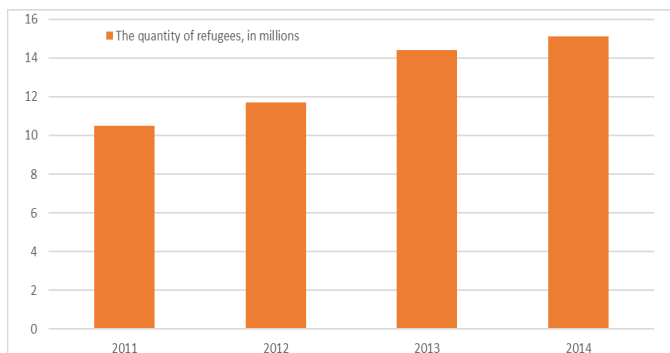


Diagram 1. Dynamics of the number of refugees in the world, million people [2]

During this period, the number of refugees in the world increased from 11 million to 15 million people.

Nowadays, the 2019 coronavirus infection (COVID-19) pandemic is putting these people in the face of a new threat, which in the end could be even direr than the one from which they were forced to leave their homeland.

According to the forecast, the outbreak of COVID-19 at a refugee camp in Cox's Bazar, Bangladesh could deplete medical supplies and beds within 58 days, leading to increased deaths from other infectious diseases such as malaria. It's a huge problem today [3].

Making a conclusion, it is advisable to clarify that the problem of human migration has become worse. Today, refugees are more than 1% of world population. We are keen to stress that uncontrolled migration can negatively affect the growth of crime and create certain ethnic clashes. These issues need to be monitored by international organizations and governments to prevent critical situations.

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## **FORMS OF MANAGEMENT IN HOTEL BUSINESS**

Hotel management is an important type of professional economic activity, which is aimed at achieving the goal through the planned organization of various resources, such as: material, labor, information. These resources are organized using different methods, functions, management principles. The purpose of management is to maintain a competitive position in the field of hospitality, which in the future should ensure the profitability of this enterprise. Profitability in the hotel enterprise is achieved by solving a set of tasks: creating an effective organization of the management structure; appropriate training and staff development at the enterprise; enlargement of material and technical base; quality service organization; extensive use of the latest research in the field of marketing.

In the hotel industry, competition is increasingly emerging, which encourages the emergence of various organizational forms of management to increase the efficiency of the enterprise. Usually, in the hotel industry there is a sole management on an independent basis. In the international management, the most common forms are: contract management, management under a franchise agreement and leasing. Below we will consider each of them separately.

### **1. Contract management.**

Contract management involves a written agreement between the hotel owner and a company or manager that specializes in managing this type of business.

Contract management today is one of the main forms in the

field of hospitality, which has become widespread since the 1970s of the twentieth century and has become an important prerequisite for the rapid development of the industry in recent decades. The main advantage of this method is a small share in the joint stock, the ability to do without its participation in the operation of hotel enterprises [1].

An important role in the economy of the enterprise is played by highly qualified personnel who have experience and extensive use of modern management systems. An important factor in concluding mutually beneficial agreements between the management company and the owner of the hospitality enterprise is the reluctance or insufficient knowledge and experience of business owners to ensure effective management, the fear of risk [1].

Contract management companies can extend management functions to an investment package consisting of a large number of hotels in the national network or a separate region of the state.

When concluding a management contract, the following conditions are regulated:

- the hotel owner has no right to interfere in the management during the term of the contract;
- financial responsibility of the hotel owner for all costs according to the operations;
- management contract is concluded for a specific period - for a period of 5, 10 or 20 years;
- the amount of management remuneration according to gross income is indicated;
- terms of contract renewal.

## 2. Management under the franchise agreement.

Franchising is a contractual partnership between hotel owners

and independent hotel companies that purchase the right to manufacture and sell on its behalf and under the trademark of the owner of a particular type of goods and services. In the modern legal and economic literature, along with the term “franchising”, the terms “franchising”, “franchise”, “franchise agreement” are used [1].

The franchisor gives the right to another entrepreneur (franchisee) to use the name, technology and methods of operation of its brand. For the franchisor, the right to be engaged in entrepreneurial activity is a kind of business development, which leads to an additional source of income, so the franchisor is interested in expanding its market network through new members. Due to the increase of the general capital and the joint decision of actual and strategic tasks, the share of expenses for marketing researches of the hospitality market decreases [1].

In the tourism and hospitality industry, the franchise agreement is very popular. In the United States, half of all franchised businesses cease operations after three years. Among companies operating in the franchise system, the bankruptcy rate in 5 years is 4%.

### 3. Rent

Renting, in other words leasing, began its development in the hotel and tourism industry in the 20th century, and at the moment this form is not popular in the tourism business. Separate leases can be observed only in public hotels, the owners of which give the management of their businesses to individual managers. Tenants are often companies with insufficient financial resources, which strengthen their position and at the same time ensure more efficient operation of hotel enterprises [1]. In most cases, the terms of the relationship between the parties to the lease are based on a net lease. The tenant himself pays for all commercial costs, equipment. This form of management has both its advantages and

disadvantages (Table 1).

Table 1 shows the advantages and disadvantages of management in the form of rent and entrepreneurs themselves decide whether this type of management will be convenient and profitable or not.

**Table 1**

Advantages and disadvantages of rent as a form of management in the hotel industry

Pros	Cons
Market penetration with small investments	The nature and term of use of resources always complies with regulations
Large selection of staff, equipment	Termination after the lease
There is a possibility of privatization of the company after the expiration of the lease	Unattractive leased premises

Corporate forms of management can be singled out. Abroad, they are widespread in the hospitality industry.

Therefore, analyzing the above information, we can conclude that quality hotel management and qualified staff is of great importance for the effective functioning of any hotel complex. Hotel owners need to choose the right and reasonable strategy for managing the business depending on the goals at the time. Each of the stages of creating a management strategy depends on the quality of interaction of all departments of the enterprise. That is why interaction is the only quality management system. Quality management is a constant process of influencing the factors that ensure the formation of quality services.

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## **BUSINESS-PLANNING AND ITS ROLE IN ECONOMIC ACTIVITY OF THE COMPANY**

Business planning is setting of goals and ways to achieve them through any planned and developed action programs that can be adapted in accordance with changed circumstances.

Business-planning is divided into short-term (1 year), medium-term (3-5) and long-term (5 and more). This process envisages development and creation of business plan that can help to do business more effectively and provide its success. The structure, content and list of indexes of short-term plan are the same as those are of the medium-term plan of an enterprise that provides co-ordination and succession of technical and economic indexes [1, p.420].

The essence of business planning is:

- setting goals, tasks that need to be solved for their implementation;
- identification of the prospects for the growth and development of the company;
- investigation of the successful ways of startups implementation;
- Assessment of the potential profit of the company and possible risks.

Business planning usually appears over time in a document called business plan. It records the main stages of the development of a business entity, the size of the investment, the period of implementation and payback of new projects, the potential threats and risks, income and other important points for the effective functioning of the company.

The main purpose of business planning is to plan the company's economic activities for the nearest and distant periods in accordance with the needs of the market and the possibilities of obtaining the necessary resources. Business planning is developed for internal and external purposes. The main external goals are attracting investment and additional monetary resources. Business plan helps to represent the company favourably, to get investors and banking institutions interested, to convince potential partners in recoupment and in benefit of the planned goals.

Internal goals. The attraction of capital is an important task, but the internal goals of business planning are more significant. They are in the development of the effective strategic programs for the company.

The business planning process has several stages, including:

- Preparation. Involves obtaining the necessary information for the preparation of a business plan (general, organizational, technical, financial, etc) and documentation;
- Definition of internal and external goals;
- Identification of potential investors;
- Defining the structure of the business plan (introduction,



description of the company, product or service, analysis and evaluation of sales markets, competitors, marketing, production plan, risk assessment, etc.);

- Elaboration of the plan;
- Examination of the document and transfer it to investors or creditors to study and make a decision on investing or lending to a company (project).

Functions of business-planning:

- the possibility of using it to develop a business strategy - is implemented during the period of setting up the enterprise and in the development of new areas of activity;
- planning;
- to attract funds - loans;
- attracting potential partners and investors to implement the company's plans

Planning methods is a way of planning, that is, a way to implement a planned idea. The choice of method depends on the specific form of planning and includes two aspects: the direction of planning and the means of justifying planned decisions [2, p.106].

In the practice of planning, there are three areas of planning: progressive, retrograde and circular.

With a progressive method, also called the “bottom up” method, planning is carried out from lower levels of the enterprise hierarchy, such as jobs, plots, departments, to the higher ones. This method of planning involves the independent preparation by lower structural units

of a detailed plan of their work, which subsequently integrate at the upper level, forming an enterprise plan [3, p.54].

In the case of a retrograde method ("from top to bottom"), the planning process is carried out on the basis of the enterprise plan (order portfolio and state order) by detailing its indicators from top to bottom in the hierarchy. At the same time, structural units should turn the plans of the levels above them into the plans of their units [4, p.146].

The circular method (counter planning) is a synthesis of the previous two methods. It involves the development of a plan in two stages. At the first stage (from top to bottom) you have to plan for the main goals. At the second stage (from bottom to top), a final plan is drawn up according to the system of detailed indicators [5, p.297].

Business planning and, as a result, the development of a business plan allows you to determine what types of activities it is profitable to be engaged in, what products are better to do or what services to provide. A high-quality business plan will help to effectively organize the economic activity of the enterprise, attract additional funds and investments for the growth and development of the company and the implementation of new projects.

The business plan is a permanent document; it is systematically updated, it makes adjustments related to changes that occur within the company, and changes in the market where the company operates, and in the economy as a whole.

Due to the fact that the business plan is the result of research of a large group of people and includes extensive organizational work, in

order to study the specific direction of the company (product or services) in a certain market in the organizational and economic conditions, it relies on:

- a specific project for the production of a specific product or service
- creation of a new type of products or provision of new services (meeting the needs, etc.);
- comprehensive analysis of production, economic and commercial activities, the purpose of which is to highlight weaknesses and strengths, peculiarities and differences from other similar firms;
- study of specific financial, technical, economic and organizational mechanisms used in the economy to implement specific tasks.

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## MATHEMATICAL MODELING OF EPIDEMICS OF ACUTE RESPIRATORY DISEASES

World-wide epidemics do not tend to decrease in number over time, but thanks to scientific and technological progress, they are easier to control. In this regard, along with other studies, mathematical modeling of their development, assessment, peak forecast and duration are of great importance.

The coefficients of the models are determined from experimental data and are not always known at the stage of the emergence of a new epidemic, therefore, it is advisable, at least for the initial assessment of the state of the process, to use the most simple and well-studied models.

Various mathematical models are now being used to explain the spread of the COVID-19 epidemic and predict its consequences [1-3].

We consider a classical model called the Bailey equations. According to this model, a group of  $N$  individuals with a common habitat is introduced into consideration. Suppose that in this group at time  $t$  have  $u_1$  susceptible individuals,  $u_2$  sources of infection and  $u_3$  remote (recovered, dead), i.e. individuals not susceptible to infection.

Suppose that the average number of new cases of the disease that appeared in the interval  $dt$  is directly proportional to  $u_1 u_2$ , and the number of individuals who left the group in the same period of time is equal to  $\mu_2 u_2$ , where the coefficient  $\mu_2$  expresses the frequency of cases of deletion. Let us also denote by  $\gamma_{12}$  the frequency of contacts between individuals of this group.

Bailey's mathematical model of the spread of infection is a system

of equations :

$$\begin{aligned} u_1' &= -\gamma_{12}u_1u_2; \\ u_2' &= -u_2(\mu_2 - \gamma_{12}u_1); \\ u_3' &= \mu_2u_2. \end{aligned} \tag{1}$$

We compared the results of our research with the results from [4], where a slightly extended version of the classical SEIR model was proposed [5, p. 61]. For data based on the nature of the course of the epidemic in France in the period 'winter-spring 2020', the results of the study within the framework of both models show that without control of the epidemic at a sufficiently large value of time  $t$ , the total number  $U$  of individuals infected reaches 87-90% of the total population  $N$ . At the same time, a abrupt intervention in the early stages of the development of the epidemic (reducing all possible contacts to a minimum) makes it possible to reduce  $U$  to almost the initial value of the number of cases. Data from these studies were also compared with studies based on the SIR model [6].

In addition, on the basis of model (1), we evaluated some results regarding the dynamics of the growth of the number of survivors of coronavirus infection in the Dnipropetrovsk region at different stages of the epidemic. The difference between our results and statistical ones is 10-20%.

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## **THE PROBLEM OF CONSISTENCING THE ARCHITECTURE OF COMPUTATIONAL SYSTEMS AND ALGORITHMS**

Since the middle of the last century, there has been an ever-increasing need to work with high-dimensional problems. These include problems in which either large amounts of input data need to be processed, or a large number of intermediate values need to be computed repeatedly. Examples of such problems can be found in many areas: aviation and aerospace engineering (simulation of air flow, trajectories of movement), meteorology (weather forecasting, modeling and simulation of atmosphere behavior), finance (processing stock and banking transactions, risk management), information technology (personalization, targeted advertising, machine learning) and others [1].

It was impossible to solve such problems with the help of available hardware in a reasonable time, which was an additional impetus for the development of computing technology. The initial stages of development were attempts to increase the speed of calculations on one processor. However, this did not allow to reach the required performance indicators: simulations and modeling took days and even weeks. In attempts to overcome this problem, a new promising research direction relating to parallelization of operations between several processors was suggested. The development of this direction required mathematicians to design methods for optimizing the efficiency of parallelization of computations.

There are several mathematical approaches to parallelizing of computations, let's dwell on the method of reduction to discrete optimization problems. In such problems the computational order is represented in the form of directed graphs, where vertices correspond to operations on data and arcs correspond to data flows.

Suppose the computational process consist of execution of  $n$  operations, data exchange between them is determined by some algorithm. We represent such an algorithm in the form of directed graph  $G(V, U)$ , where vertices correspond to operations and arcs correspond to transfer of results between them. It is assumed that the execution time of all operations is the same.

Now let us introduce mathematical formalizations of the algorithm's parallelization scheme, computation completion time and number of processors.

Definition 1. The parallel sequencing of the vertices of a directed graph  $G = (V, U)$  is such a placement of the vertices of the digraph in line-arranged places such that the fact that the pair  $(i, j) \in U$  implies that vertex  $i$  is located in the sequencing  $S$  to the left of vertex  $j$ , i.e. from the fact that  $(i, j) \in U \wedge (i \in S[p], j \in S[q])$  implies that  $p < q$ .

Definition 2. The length  $l$  of the sequencing  $S$  is the number of non-empty places in it:  $l(S) = \sum_{i=1}^n \text{sign}|S[i]|$ , where  $S[i]$  is the set of vertices that are placed at position  $i$  in the sequencing  $S$ .

Definition 3. The width  $h$  of the sequencing  $S$  is the value equal to the greatest number of vertices placed at one position:  $h(S) = \max_i |S[i]|$ , where  $i = 1, \dots, n$ .

Classical problem. Given a graph  $G$  and a sequencing width  $h$ , construct a parallel sequencing of the minimum length.

Along with the classical problem, its generalizations are considered that take into account the additional constraints inherent in the execution of algorithms in computing systems.

In the case when the execution time of operations can be different from one another, problems in which one vertex can occupy several positions are scrutinized.

Problems with complex structure of executors and additional conditions are considered in order to approximate real conditions of processors' functioning within the framework of computational system. For cases where at different moments of time different number of processors are available, problems in which on  $i^{\text{th}}$  place there can be  $h_i$  vertices are introduced. Also, for the cases when execution time of operations can be different, it is relevant to consider problems with preemption (execution of operation can be stopped and continued later). To take into account the time spent on information transferring between processors, problems with communication delays are contemplated. Among the problems with additional conditions, it is worth highlighting the problems arising when it is necessary to regulate the start time of operation execution. The most interesting variant of this problem is online-problem in which we learn about operations and structure of the graph of the algorithm in the process of their execution, that corresponds to assignment of incoming tasks to processors in computing systems.

All the described problems are NP- hard, which means that it



is impossible to construct optimal schemes of algorithm parallelization in the general case in an admissible amount of time. Exact polynomial algorithms are known only for special conditions, and therefore they are narrowly applicable. Regarding that, efficient parallelization schemes have to be devised for each specific algorithm.

In view of all the above, the development of new approximate polynomial algorithms and heuristics that make it possible to more accurately find solutions to such problems in the general case is inextricably linked with the ability to efficiently and quickly solve high-dimensional problems.

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## **INNOVATION ACTIVITY OF THE ENTERPRISE**

Innovation is the improved or created technologies and services as well as organizational and technical solutions that improve the quality of the enterprise's products, its competitiveness and production activity on the whole.

Innovations can be related to the:

1. Product (new technology implementation);
2. Process (development the up-to-date production methods using of well-known technologies in a new manner) [2].

The innovation activity of an enterprise is an activity aimed at finding and implementing innovations to increase the range and to perfect the quality of products as well as to improve technologies for manufacturing of these products.

The main reason for the existence of the innovation activity of the enterprise is that sooner or later everything might become outdated, break down and slow down the development of production and the enterprise on the whole. To avoid this, it is necessary, from time to time, to recheck the goods, technologies and workplaces of the enterprise as well as constantly analyze the market. In other words, it is necessary to diagnose processes as often as possible in order to prevent the company from being forced out of the market by competitors.

Innovation activity considers three main issues:

1. Identification of enterprise's problems;
2. Implementation of the innovation process;

### 3. Establishment of innovation activity [4].

Innovative projects and programs, new knowledge and other intelligent products, production equipment and processes could be the objects of innovation activity.

Subjects of innovation activity are individuals, companies or communities that attract property and intellectual values and also invest in the introduction of innovation [1].

Organization of innovation activity involves the formation and reorganization of structures that drives innovation processes.

The organization is carried out in three stages.

The first stage is creation. That is the formation of new enterprises or other structural units that will implement the latest technologies and processes.

The second stage is acquisition. A larger company acquires emerging innovative enterprises with similar activities. This mechanism allows entering the market with a new, improved product in a minimum amount of time. Acquired firms also remain in an advantageous position as new enterprises do not always have costs to implement innovations.

And the third stage is selection. During this stage, independent innovative enterprises, which used to be a part of an integral system, are created. It makes sense to implement this mechanism when a new activity is formed and that is not related to the main specialization of the company.

Innovation can be organized in three ways:

1. When an innovation is created and developed within the enterprise;

2. When the wish to create and develop innovation is approved

by the two firms;

3. When a company creates a subsidiary to implement innovations [3].

By and large, the second method is implemented at the enterprises.

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## **BITCOIN AS A MODERN FORM OF DIGITAL CURRENCY**

Cryptocurrency, unexpectedly, broke into our lives in 2009. It was Bitcoin, which still remains the most popular crypto. It should be noted that it appeared quite quickly – the development took only 2 years. The name of the author or even a group of authors still remains to be a top-secret, but their pseudonym is known: Satoshi Nakamoto. The first 50 Bitcoins were generated on 3 January. The first transaction was made in 9 days. And already in 2010, the American bought two pizzas, paying with cryptocurrency [1].

The undoubted advantage of Bitcoin as a currency is that it is completely decentralized, i.e. no institution can regulate or protect the value of coins. Moreover, it is not printed as our usual money. Thus, Bitcoin is completely beyond the control of the world's major banks. What is more, using cryptocurrency as a means of exchange, we ignore the usual credit cards, which are becoming more prone to scam.

Nowadays, electronic money is almost the same as a deposit in a bank account. Any person can create an account in an electronic payment system that helps to invest money or run e-business [2].

Any currency must first gain the consumer's trust for viability. The followers of cryptocurrency think that the most valuable system of payment is that one which has no "third party". In this case, the trust aspect is in a computer program that is unable to deceive its users [1].

Despite the original idea of creating Bitcoin, today almost

nobody evaluates goods or services in such a currency. It is increasingly gaining the status of fiat, i.e. it does not require to be exchanged for anything at all. This happens due to the volatility of the cryptocurrency, that is to say, because of the sharp price changes that prevent from using it as a means of payment or accumulating value. For the same reason, cryptocurrencies cannot be used as a means of payment. Although it is well-known fact that many international companies, such as Facebook, Google, Uber, pay their remote employees in cryptocurrency because such transfers are fast and relatively cheap.

Paying salaries in cryptocurrency is a leap forward to start its widespread use in everyday life. "If tomorrow the world's rulers say that oil and gas can only be bought for Bitcoin, then it will be almost like dollar", said Doctor of Economics Georgy Sigua.

Despite the recent popularization and growth of Bitcoin, it is unlikely that the countries' central banks will begin to transfer their funds to cryptocurrency. This is because gold is still one of the most reliable option for investment, and the chance that it will ever devalue comes to naught. But partial storage of funds and its accumulation is more appropriate in Bitcoin, as its price increases several times as fast as the price of oil, stocks or gold. As for the dollar or the euro, these currencies devalue relatively quickly due to the stimulating measures of the economy [3].

To sum up, it should be outlined that Bitcoin has become a completely new form of digital currency. Meanwhile, the question whether Bitcoin is money or goods is still open. Cryptocurrency does not yet affect the monetary policy of the world as it is completely uncontrolled. It is difficult to understand whether decentralization plays a positive or

negative role here, but thus the losses of the world economy should not be reflected in the cryptocurrency market. In addition, the new currency market is growing rapidly, and Bitcoin may become a new gold one day.

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## **WORLD DEVELOPMENT OF NEW TYPES OF TOURISM**

Nowadays there is a continuous development of almost all spheres of human life. Tourism is one of those areas that never stands still, but is constantly in the process of development and renewal. Our planet has a significant tourist potential, which has not yet been studied, and therefore the motives for travel and new experiences are inexhaustible.

Before the COVID-19 pandemic, the tourism sector accounted for 10.4% of world GDP, every 10th job on the planet, 6.5% of world exports in 2018. Moreover, over the past 70 years, international travel has grown by 5500% and reached 1, 4 billion international flights, and the number of domestic tourist flows is 4-5 billion annually. Taking into account the dynamic changes of globalization processes, the growing needs of consumers of tourist services, new trends in the development of the tourist market are being formed. According to these trends, new types of tourism are emerging. Several types of tourism are under consideration in this research. They have only recently appeared in the classification of tourism, but have already had their supporters.

According to the World Tourism Organization (UNWTO), tourism is a key factor in the recovery of the world economy, and is important in creating new jobs, combating poverty, protecting the environment, preserving peace and mutual understanding between peoples. That is why in the theory and practice of world tourism there



are new trends that direct the development of society to the cognition of the world, a caring attitude to it. At the same time, informatization and digitalization determine another vector of tourism development, the purpose of which is its own achievements and demonstration for the sake of general approval. One of these new types of tourism is selfie tourism. Selfie tourism is travel that focuses on your own photos against the background of iconic (popular or inaccessible) places. It should be said that the location of the monuments themselves in the photo is not important at all, they may be somewhere far away, look from behind the shoulder, or they may not be visible in the frame.

The direction of selfie tourism has become popular thanks to the social networks developed nowadays. For example, 1 billion people visit Instagram every month, and 500 million use Instagram daily, where they post their own photos. Now the phone is an integral part of human life, so it is not surprising that this type of tourism is combined with others. If the main motive of the trip is determined by somebody's own photos for posting them on social networks, then this type of tourism can be classified as selfie tourism. It is worth noting that this type of tourism is popular among both women and men of all ages. The main destinations among selfie tourists are France (especially the Eiffel Tower and the Arc de Triomphe), Great Britain (Big Ben, the streets of London and, of course, local colorful double-decker buses), Germany, the United States, and East Asian countries.

Not all tourists are satisfied with just ordinary photos on the background of must-see spots. They strive to add some kind of extreme, new experience and impressions. So, a photo on the top of the Eiffel Tower, on the roof of a skyscraper or train can be a purpose

of the travelling. Gaining new experience and testing your own strength in modern tourism is often a compelling motive, traveling to achieve a record. Tourists who want to make such a trip apply in advance to the Guinness Book of Records. Basically, this type of tourism is associated with some extreme actions: the conquest of mountain peaks, long bicycle trips or long hikes and marathons. Tourists prepare for such a trip for a long time and consciously in order to achieve a record as well as a certain goal. Traveling to gain new experience and test your strengths and capabilities has become one of the trends in tourism in the XXI century.

Jailoo-tourism can be considered a kind of extreme tourism. It is preferred by the people who want to immerse themselves in the atmosphere of not only antiquity, but also of learning the life of the indigenous population in its origins, without modern equipment or the achievements of civilization. The trips of this kind used to be popular among the scientists, researchers and professional travelers. Nowadays, more and more often this type of tourism is chosen by tourists who are not afraid of combining it with something unknown and sometimes wild. Popular destinations include the forests of Siberia and North America, the jungles of the Amazon, Africa and the steppes of Kyrgyzstan.

Another trend of the 21st century is to take care of your own health and appearance. It is this factor that determines the popularity of medical tourism. This type of tourism has its origins in health tourism, which was popular since the ancient times, due to the healing properties of natural resources. Modern medical tourism often has an international form and is associated with the organization and provision of various medical services. The main consumers of medical tourism services are

people who seek medical care outside their place of residence. The great advantage of such tourism is that tourists can take the opportunity to combine medical travel with recreation at resorts, various health clubs, as well as to realize cultural and cognitive motives (excursions, visits to museums, parks, galleries, etc.). Popular destinations among medical tourists are the United States, Germany, Austria, Israel, Turkey, Japan, Switzerland, Romania, Poland. Along with medical tourism, various spiritual practices are becoming important. The promotion of spiritual purification, self-knowledge, knowledge of Zen and the discovery of one's inner world become the goal of spiritual journeys. Currently, popular destinations for spiritual tourism are Thailand and India.

A new type of tourism is worth noting, i.e. film tourism, which means travel to visit locations where favorite movies, TV series and more were made. The fans of the cinema are ready to fly all over the planet to see the familiar landscapes, buildings, follow the route of the favorite film hero and go to the establishments that were involved in the film. On such trips, tourists can stand in line for hours and days to get to the filming area and take a few photos. Some destinations owe their popularity to the films that were shot there. The most popular has always been New York - a city that has been in the frame of many famous films. You can walk through the streets where Godzilla or King Kong ran, see the skyscrapers that moved Spider-Man himself as well as to see the same lattice from which the air lifted the skirt of Marilyn Monroe.

Another fabulous place, which is still experiencing a real influx of movie tourists is New Zealand, the town of Matamara, known for filming the trilogy "The Lord of the Rings", where a village of hobbits

was specially built.

Tourism covers all world destinations, the diversity of which allows both meeting the needs and realizing the tourists' travel motives in accordance with the changing market trends and turbulence of the environment.

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## **INFLATION PROCESSES AND THEIR PECULIARITIES IN UKRAINE**

First of all, it is necessary to distinguish between internal and external factors of inflation. They both complemented each other, which did not lead to the best results.

The decrease in a production led to a decrease in tax revenues to the state budget, which constantly reduced. It was not possible to close the holes using non-tax revenues. This increased the money supply and, accordingly, inflation.

Privatization has played a positive role in anti-inflation policy, but unfortunately, it has been insignificant. Criminalization and concealment of real income for non-payment of taxes have become the basis for the expansion of the shadow economy [1].

Because of the reduction of state aid, enterprises did not pay salaries on time or stopped paying at all. The growth of mutual debt between enterprises was largely due to the strict policy of the NBU. On the one hand, it reduced inflation by reducing the amount of lending, but, on the other hand, it did not contribute to economic development.

The tax system is an important factor in raising inflation. These were indirect taxes that formed the basis of tax revenues in the treasury of Ukraine. Accordingly, prices were increased for cash inflows, which influenced inflation.

The change in prices was also caused by external factors as the value of imported goods was influenced the other commodities. Thus,

rising energy prices in Russia and Turkmenistan led to an increase of the price for domestic goods (both relevant oil and natural gas and also goods from other industries) [2].

Barter in the foreign economy had a very large impact on inflation in Ukraine. A significant percentage of turnover contributed to the concealment of the real value of enterprises in transactions, and therefore the failure of the state to receive funds in the form of taxes. It also caused the export of capital from Ukraine, which in turn contributed to inflation.

During the transition period, it was quite logical to spend money quickly, which became less valuable every next day. This prompted an orientation to another, more stable, currency – the dollar. Besides, dollarization also did harm to inflation, because the amount of the dollars was greater than the amount of the national money supply.

Investment. Undoubtedly, the increase in investment in the development of the transition economy contributed to the reduction of inflation. But, on the other hand, it forces the country to pay dividends and percentages and reduce the money supply in its turnover. A decrease in the money supply leads to an emission method of increasing it and, as a result, to inflation [3].

In conclusion, it could be said that Ukraine had a number of external and internal factors which worsened its situation due to the inflation such as decrease in the volumes of production, tax revenues, criminalization of the economy, dollarization, etc. All the above-mentioned led to special inflationary processes that caused hyperinflation.

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## **MEDICAL TOURISM DEVELOPMENT OUTLOOK IN ASIA AND THE PACIFIC**

Due to the global processes and IT development, there are considerable changes in the world. Special mention should be paid to the changes in medical care in which medical tourism services are of primary importance. Medical tourism is intentional consumption of medical services by patient outside his permanent residence with the opportunity to visit the sights of other countries [1].

Currently, more and more countries invest in this type of tourism: they set up organizations and schools for the training of highly qualified personnel, build clinics which have state-of-the-art equipment, develop and apply the latest therapies of different kinds of diseases and body rehabilitation. According to the explanation of Caliber Research platform, the value of medical and health tourism under pandemic COVID-19 is estimated at \$735,8 billion, and it is expected to increase to \$1,2 trillion by 2027 [1]. 23,1 per cent of world market share of health tourism was in this segment in 2020, but after the pandemic, the further growth by 12 per cent is forecast which is the sign of its future development.

Thus, Asia-Pacific countries are the leaders in the development of medical tourism. According to the findings of «Market Data Forecast» Consultancy, market share of medical tourism in 2020 was \$7,79 billion and its annual average growth by 22,4 per cent is forecast [2]. Resources and regional traditions are the cause of high-level demand and additional, alternative and holistic methods of treatment. Traditional resorts are transformed into multifunctional tourist centers with a wide range of medical and health services. Thereby, the leading countries



in development of medical tourism in this region are Singapore, Japan, North Korea, Thailand, China, Malaysia and Australia (table 1).

**Table 1.** Trends in medical tourism in some countries of the Asia-Pacific region.

Country	Development trends
Singapore	Promoting a healthy lifestyle Preventive activities Particular attention to the quality of drinking water and personal hygiene products
Japan	Advanced cancer treatments Success in cosmetic surgery Safety and quality of services
North Korea	Rigid quality control system Active use of high technology and robotic surgery Main directions: plastic surgery, dentistry, complex treatment, oncology, infertility treatment
Malaysia	Allocation of MTNS from the budget for 2020 \$ 6 million to consolidate positions Promoting the importance of physical and mental well-being Marketing activities
Australia	Experience of specialists and modern equipment Popular areas: orthopedic surgery, cardiology, oncology (various types of cancer), urology, organ transplantation, overweight problems and IVF

Table 1 shows the trends in medical tourism in each country. According to the Medical Tourism Index 2020-2021 (below MTI), Singapore takes the second place after Canada in the level of service quality, safety and destination attractiveness [3]. Health Care Ministry is constantly promoting a healthy lifestyle and applies prevention programs aimed at health conservation and livelihood support. Advanced technology of treatment adoption allows Singapore to provide high quality services.

Japan, having taken the third place in this rating, has developed advanced cancer treatments and gained special confidence of patient-tourists in modern therapeutic methods of cosmetics surgery that attracts the attention of medical tourists. North Korea takes the 6<sup>th</sup> place by

indices of medical tourism development and the 1<sup>st</sup> place by the number of conducted plastic surgeries performed per capita [4].

High-technological treatment methods and robotic surgery are in a great demand in Australia attracting tourists from New Zealand, USA and more often from Asia. The Malaysia Healthcare Travel Council (MHTC) in collaboration with «Malaysia Airlines» and «Eithad Airways» have been actively promoting medical tourism since 2020. Their task is to attract tourists not only from Asia-Pacific region but also from Europe and Middle East [5].

In conclusion, medical tourism develops rapidly as a modern type of specialized tourism. Asia-Pacific countries generate and receive huge international tourist flows. An increase of medical tourism popularity is caused by integrated approach to tourist services combining the application of update examination procedures and treatment, high-level services, availability of attractive infrastructural, historical and cultural as well as natural resources.

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## **UNEMPLOYMENT RATE IN UKRAINE UNDER PANDEMIC COVID-19**

Amazingly, unemployment plays a leading role in the economy of any state. Undoubtedly, it has both negative and positive consequences. The latter includes:

- The labour force reserve (the economy always needs workforce);
- Increase in the general level of qualification;

(as mentioned above, the existence of the unemployed members of society increases the competition between them and the employed population. This encourages workers to increase their own productivity);

- Competition for the job  
(it creates choices for the employers);
- Value of the job among workers.

But unfortunately, negative aspects have a greater impact in this category, among them:

- Low incomes of humanity.  
(leading to a low standard of living);
- Great competition for a job;
- An advantageous position of the employers

(due to the increased unemployment, the employer is able to dictate his conditions regarding working hours, wages, remuneration, perks for the employee that can lead to the insufficient pay for working

hours);

- Increase in criminality  
(due to the lack of money, a person is capable of stealing);
- Reduction of the potential GDP of the state.

Unemployment is the biggest problem in Ukraine today. With the pandemic, the unemployment rate has started to gather momentum and a lot of people have lost their jobs. The situation has been acute since 2020 and has become even worse in 2021. If in January 2021, 485.3 thousand people were unemployed, the figure for the previous year was 33% lower than in the base year. The unemployment rate decreased in all regions of Ukraine and among all age categories [2].

**Table 1.** Unemployment rates in Ukraine from 2017 to 2020  
excluding the occupied territories

Years	Total population	Economically active population	Employed population	Unemployed people	Unemployment rate	Registered unemployed people
2017	42386,4	17193,2	15495,9	1697,3	9,9%	352,5
2018	42153,2	17296,2	15718,6	1577,6	9,1%	341,7
2019	41902,4	17381,8	15894,9	1486,9	8,6%	338,2
2020	41588,4	16917,8	15244,5	1673,3	9,9%	459,2

Compiled with source [3]

(population in thousands)

State support is essential. So, during the lockdown period, the Ukrainian parliament imposed a law, which provides payments to workers who are currently unable to work at full capacity due to a range of pandemic restrictions [4], to assist certain groups of the able-to-work population who lost the jobs during the pandemic.

Thus, we can say that the Ukrainian labour market has sufficiently suffered not only from the conditions of the corona crisis in terms of unemployment but also in terms of wages. According to the job search sources, the average salary in 2020 decreased by almost a thousand hryvnias. However, the market is currently beginning to adjust to the innovation of this kind and is slowly recovering. Due to the easing of the lockdown restrictions in July 2020, the labour market is slightly recovering, which leads to the wage increase and the improvement in the overall economic level of the country [1].

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## **Секція 4**

***Актуальні проблеми інженерно-технічних  
наук та новітніх інформаційних технологій***

## **ARTIFICIAL ORGANISMS AND ARTIFICIAL EVOLUTION**

Researches on artificial intelligence and artificial life are relevant because of the benefits that technologies based on them can provide to society. These technologies can take humanity to the next level of its development. On the basis of the results obtained earlier in the relevant studies such algorithms were developed that are able to solve problems which, at first glance, cannot be developed due to additional computational technology. That's why researches on artificial life and genetic algorithms can be useful for obtaining new data on the behavior of such systems.

Typically, such systems are implemented in computer technology using programming languages. This way an artificial environment is created for the development of populations of artificial organisms that have the characteristics of real living organisms, to study how to reproduce in a virtual environment a system that will behave like the corresponding biological systems. Of course, any biological systems, such as organisms, their organs, living cells, ecosystems, are too complex to be easily reproduced, so a researcher in this field creates his own artificial analogues of these systems and the environment in which they exist. To investigate how similar these systems are to real biological systems, real-world analogues are used to obtain information about how successful these analogues are. To do this, a known mechanism that operates in a biological environment is used and called 'natural selection' [1].

The essence of this mechanism is that any biological system, in particular living organisms, contains some information that determines

exactly how this system will interact with the environment in which it is located. Usually its implementation is determined by the parameters. Once the researcher creates these systems and the environment in which they are located, he gives random values to their parameters. Then the researcher 'turns on' the mechanism of natural selection. For each such system he determines the parameter  $fi$ , which evaluates how close the behavior of this system is to what the researcher would like to obtain. After the researcher determines this parameter for all organisms, he, according to a certain rule, selects organisms with the parameters closest to the desired ones. In the next step, the researcher makes copies of the selected systems. In some of them he changes the parameters responsible for their interaction with the environment, as a result of which the adaptability of these systems will increase with non-zero probability. The researcher repeats this process until the parameter  $fi$  acquires a certain value he would like to obtain or approaches one of these (optimal) values [2].

Thus, these systems seem to 'evolve' and, finally, this mechanism selects such parameters at which interaction of these systems will be close to what is expected. Therefore, to determine the best values of internal parameters in complicated tasks you can create a program that will find them using genetic algorithm.

Although such algorithms have their drawbacks, they are still effective in solving a wide class of 'complex' problems, for which it is very difficult to find a fixed algorithm without parameters, which would properly solve the problem immediately, without consistent optimization of parameters.

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## **EXPERIMENTAL STUDY OF 3D PRINTED ORIFICES AND CENTRIFUGAL INJECTORS**

One of the most important aspects of the implementing of the new technology is its adaptation. Typical additively-manufactured components should be tested in order to ensure their proper operability.

The results of the injectors and orifices testing are presented in the work. The components were manufactured by means of SLM (Selective Laser Melting) technology as well as tested in FlightControl Propulsion company. The study is the continuation of the work, presented in [1]. Repeatability of hydraulic characteristics of 3D printed injectors was the main direction of the experimental study. Repeatability of hydraulic characteristics is a difference between dependencies of mass flow rate versus pressure drop for equal specimens. Three variants of the injectors were considered in the work: spray injectors and two options of centrifugal injectors. The first type represents the simplest model of the orifice. The rest of manufactured injectors represent centrifugal with different geometric parameters. The orifices were manufactured with varying of the geometric parameters: nozzle diameter and nozzle length. Nozzle diameter varied in the range from 0.5 to 1 mm. Relative length varied in the range from 1 to 6. The hydraulic characteristics of the 68 orifices were obtained while testing of the specimens. Each orifice was tested three times for each specified pressure drop. Mass flow rate was defined using the weight method (when water discharges

into container through an element over a period of the specified time and then it is weighted in order to determine the obtained mass; then a simple calculation used to determine the mass flow rate). The study of the 'open-type' centrifugal injectors was carried out for two options: with and without nozzle edge fillet of the injector. Five specimens for each design geometry of the injectors were manufactured. Five different working modes were tested for each specimen. Each injector was tested 3 times for the specified pressure drop. The same study was carried out for 'closed-type' centrifugal injectors. The study of the 'closed-type' centrifugal injectors was carried out for two options: with and without nozzle edge fillet of the injector. The total amount of testing injectors is 88.

The analysis of the experimental results allows to formulate the recommendations to the SLM technology in terms of manufacturing of the LRPE components and determine necessary geometric dimensions which ensure required repeatability of the hydraulic characteristics of the injectors.

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## **THE LATEST INFORMATION TECHNOLOGIES FOR MODELING PROBLEMS OF MECHANICS OF DEFORMED SOLID**

Nowadays, there is an increasing need for digital modeling and analysis of various processes. One of the most important processes for research is the mechanics of deformed solid and the contact interaction of bodies. However, unfortunately, today most of the problems of mechanics are impossible or extremely resource-intensive to solve in analytical form. Therefore, numerical methods and appropriate software are used increasingly often to solve these programs.

There is an extremely large number of computer-aided design systems. Today, suitable simulation software products exist for major operating systems; some even support multiple operating systems. And even if a certain computer-aided design system is not on the desired operating system, it is always possible to choose another system that supports this platform. All of them provide a wide range of opportunities for modeling in one or more applications, but the main disadvantage of such systems is the relatively high cost and extremely high demand for computing power of the machine on which it will run. Also, extreme flexibility in solving problems of computer-aided design systems leads to a loss of accuracy in solving certain types of problems.

To solve these problems, it is better to develop your own software application, which will be aimed at solving a certain type of problem with all its features. The main trend in modern software

development is the transition to cloud computing, i.e. the creation of a software product that would be built on thin client architecture, and would transfer most of the tasks to a high-performance server. Such an approach would ensure high-quality multi-platform and significantly reduce customer requirements on the customer side.

One of the key elements of engineering software is the visualization of the result to analyze the process under study. The main technology for working with graphics in the browser is WebGL, and the corresponding wrapper libraries that implement a user-friendly interface to work with it. Among such libraries, the most popular are Three.js [2], and Babylon.js [1]. Both libraries provide a wide range of capabilities and a numerous ready-made solutions, but Babylon.js is a higher priority for use, as it provides more flexible implementations and has more built-in functionality for working with geometry. Another advantage of Babylon.js is the native support for TypeScript [3]. TypeScript is an open source language based on JavaScript; one of the world's most widely used software development tools, adding static typing. Types and interfaces provide a way to describe an object, provide better documentation, and allow TypeScript to verify that your code is working correctly. TypeScript is backward compatible with JavaScript. In fact, once compiled, a TypeScript program can be run in any modern browser or shared with the Node.js server platform. The basic principle of the language is that any code in JavaScript is compatible with TypeScript, i.e. in TypeScript programs you can use standard JavaScript libraries and previously created developments. Moreover, you can leave existing JavaScript projects unchanged and place typing data in the form of annotations, which can be placed in separate files that will not interfere with the

development and direct use of the project.

Therefore, writing your own software product to solve the problems of modeling contact interaction is extremely relevant and necessary. Solving the problems of the mechanics of a deformed body has a wide range of applications, and improving the quality of calculations in this area will improve the analysis of this process. In the future, such improvements can significantly reduce the cost of production, prototyping, etc.

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## **THE USE OF MOBILE APPLICATIONS FOR RECOGNITION, ACCOUNTING AND PROVISION OF INFORMATION ON THE PHOTO**

Mobile development is a very rapidly growing area of programming, as the number of mobile devices significantly exceeds the number of personal computers, and this trend will only grow. Computer vision is a technology that allows you to detect, track and classify various objects (both physical and virtual). Finally, machine vision makes it possible to replace people with robotic systems in hazardous industries, significantly reducing the number of accidents at work. It is not surprising that interest in such technologies is growing all the time. Technologies in the world: according to GlobeNewswire, sales of video analytics products in the world will grow by an average of 18% each year, exceeding \$ 11 billion by 2025. The most demanded solutions will be in systems for motion detection, face recognition, license plate reading and human traffic assessment [3].

An application has appeared that can count the calorie content of food from a photo. Now, a mobile phone will help you follow a diet. French developers have created the Foodvisor application, which, based on a photo, determines the calorie content of food on a plate and the weight of individual components. Algorithms use deep learning technologies to calculate the distance of food from the camera and the area that a particular food occupies on a plate. Then the application analyzes the data and draws conclusions: how much your dish weighs,

and how many calories it contains. It will also show the content of proteins, carbohydrates, fats and fiber in the lunch, as well as make up a 'usefulness rating' and advise which foods should be given up for good looks and health. Also, in your personal account, you can record data about your physical activity and communicate with a personal nutritionist. The application was launched in France. It can now be downloaded in the UK, Germany, Spain, Italy and the US. For almost 2 years, the startup has attracted about \$ 1.5 million from investors and buyers. The idea of such an application is not entirely new on the market for mobile devices - there are already many programs that select a diet, offer recipes and prepare a training program. Users can share their successes with social networks subscribers or choose their rivals and try to surpass their results [1].

At the same time, the PolitScanner application was launched in Ukraine that scans a politician's photo and publishes a dossier on him, informs about his activities. The application is based on face recognition technology. The essence of the application is that voters can scan an image of a politician from any advertising media and get information about him and his political activities. So, after pointing to the image of a candidate, the user is asked to find out his biography, election program, declaration and political history [2].

The developers believe that with the help of such an application they will be able to raise public awareness of the election process and involve young people who with the help of technological solutions will be able to better navigate in modern politics. The application needs to be downloaded to a mobile device, and then point the phone camera at the image of the politician who interested the user. Detailed information

about the policy can be obtained within a few seconds. With the help of the application, the voter can analyze the image of a politician on any electronic medium (TV, tablets, mobile devices), as well as in newspapers, brochures, billboards, where there is a photograph of the candidate.

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## MENTAL ARITHMETIC AS A MODERN METHOD OF STUDYING AN ORAL ACCOUNT

*Sooner or later, any mathematical idea  
finds its application in a particular case.*

*A.N. Krylov*

Mental arithmetic is a program that, using arithmetic computation in ancient Japanese Abacus accounts (fig. 1), develops a person's mental and creative abilities and teaches instantaneous and correct oral scores.

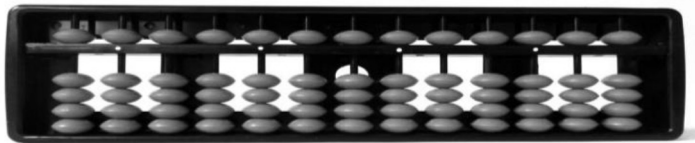


Fig. 1. Abacus

The history of this technique comes from a distant past and remains interesting nowadays. She arose in ancient Greece and Mesopotamia. It was an abacus that looked like a board with special signs and bones that hung on thin sticks. It was called Abac [1, p.79]. Three main types of Abac were created: Japanese, Russian and Chinese abacus. This technique later appeared in Japan and China and has now become popular around the world. Over time, the abacus turned into a calculator. In 1993, the concept of 'mental arithmetic' was

established in Asia. Mental arithmetic obtained quite high results in Moscow and Astana. In Japan and China, this program has become part of the school program [1]. The technique of solving arithmetic examples with an abacus is included in the list of oral and intangible heritage of UNESCO. Modern Japanese believe that the calculation on the abacus has more advantages than the usual calculation on paper.

The purpose of mental arithmetic is the harmonious development of the brain, memory, speed of thinking, and attention. You have to train every day to develop your intelligence. According to the authors of the work: «Children aged 4-5 years learn the technique of oral accounting best» [2, p.10]. Many children come to school with some difficulties, which are reflected in the lessons. It's restlessness, bad memory, distraction. When children begin to engage in mental arithmetic, they learn to count faster both on the abacus and mentally with each lesson.

Today, there are quite a few exercises to practice oral math (without the use of mental mathematics). For example, how do you verbally multiply any two-digit number by 11? It's very easy if you know the secret. The following situation needs to be presented:  $25 \cdot 11$ . To solve this problem, the numbers  $2 + 5 = 7$  should be added and then 7 placed between 2 and 5. Have an answer : 275. Prove this method with a simple column multiplication, for any two-digit number  $ab$ :

$$\begin{array}{r}
 \times ab \\
 \hline
 11 \\
 \hline
 + ab \\
 ab \\
 \hline
 a a + b b
 \end{array}$$

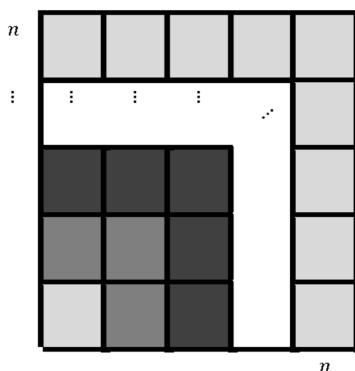
The following example shows how to raise to a power. To

square the number 25, we simply multiply the first number (2) by the next number in the hierarchy (3), then add the number 25. In general, to square  $ab$ , you have to multiply a by  $a + 1$  and simply add  $b$ . To give another example: the sum of any number of consecutive odd numbers (starting with 1) is always the square of the number of numbers, attached:

$$1 + 3 + 5 + 7 + 9 + \dots + (2n - 1) = n^2.$$

Let's illustrate the proof graphically:

The use of formulae is an advantage of mathematical methods.



It is not necessary to count the sum of all numbers, and knowing their number – immediately to say the sum. It will only take a few seconds, and if you use oral mathematics, the more  $n$ , the more time it takes to calculate. The advantages of mental arithmetic are that it trains visual, auditory, and motor memory, and promotes multitasking of the brain and visualization of what is heard. This technique allows the development of both the left and right hemispheres of the brain. It helps to apply its intellectual reserves. The opponents of mental arithmetic are teachers

who don't accept new techniques in the study of mathematics and believe that it interferes with the study of the school curriculum. As a future mathematics teacher, I believe that mental arithmetic is a good program for developing verbal arithmetic and improving memory. I think that science is not standing still and every teacher should be modern and creative. The material that comes out should be interesting to the students. So that in the future they would have logical and abstract thinking. Mathematics is an important science that can be mastered in the natural sciences and humanities. In my opinion, mental arithmetic has minor shortcomings in its application. The main one is irregular attendance. It should be added that not all children who study this method at the age of 4-16 will use it in adult life. Only a few percent choose a profession related to mathematics, the rest – the humanities or science.

So we can conclude. Mental arithmetic is better used as an additional tool to ordinary numeracy skills to interest children in math classes. It should also be added that this method is now very popular on social media. People make interesting videos that show life-hacks. I mean, verbal computing exercises: addition, multiplication, exponentiation, etc.

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## **BUILDING A LEARNING SYSTEM BASED ON MULTI-AGENCY AND SYMMETRY**

In almost all tasks of recognition of images and algorithms of learning, an important part occupies the search procedures of system parameters. Often, the target functions of such tasks contain the complex nature of the response surface, a large number of local extremes, is roaming, which significantly complicates the task of finding extreme values. The search for the solution of this problem can be sought in the direction of building such computing procedures that significantly expand the capabilities of searching for the basis of known optimization algorithms.

The proposed by the second author and in the future a significantly developed method of combining the symmetric transformation of the objective function with the subsequent organization of pairwise oncoming movements using a symmetric scheme of interaction of the parameters of the control object made it possible to solve the problem of identifying systems using a generalized input [2, 3, 4, 5]. The indicated approach provided a monotonic and stable character of motion to the optimal values of the system parameters when solving the identification problem and an asymptotic approximation to the value of the extremum in the optimization problem. The application of the proposed symmetric approach allows, in many cases, to abandon the second-order optimization methods with expressions for the second derivatives, in favor of simple gradient procedures, given that the calculations of the

derivatives themselves can be performed with errors.

The concept of parallelization of movements when searching for an extremum is in good agreement with the ideas of the actively developed multi-agent approach [1, 6, 7, 8, 9]. By an agent we mean a depicting point located in the parameter space of the system. An agent has a number of basic properties necessary for solving a learning problem: autonomy (the behavior of an agent is determined by the target function and only by those agents with which it is associated), group behavior (the ability to function in a community with other agents), reactivity (the ability to perceive the state of the environment and react to its changes), pro-activity (the ability of an agent to take the initiative and determine the behavior of other agents). The formation of a multi-agent set of parameters occurs by representing functional functions by a two-, three-agent set, where the agents will actively interact with each other. The organization of interaction is achieved by constructing a symmetric multi-agent function of the target. The symmetry of the constructed multi-agent function is manifested both on the object and with respect to the transformation of the response surface. The number of agents can be increased to any number.

The proposed multi-agent approach can be used to determine the performance characteristics of a learning control system for an object, the transfer function of which includes a finite set of parameters to be adjusted, and the remaining elements are uncontrollable and somewhat unpredictable. For a constant environment, the use of a multi-jet symmetric tuning function will ensure the end of the tuning trajectory at the optimum point. With a slow change in the environment, the method

guarantees an asymptotic approximation to the optimal value of the system parameters. In the case of a rapid change in the environment, the combination of multi-agent and hopping learning allows you to build the structure of the learning circuit.

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## TWO FAMOUS CHESS PROBLEMS

*«Playing chess is not just idle entertainment.  
Some very valuable qualities of the mind,  
necessary in human life,  
are required in this game and  
are strengthened so much that become a habit  
which is useful in many cases of life».*

*Benjamin Franklin*

Chess is a game originated in India. Scientists agreed in their dispute, and came to the conclusion that chess arose in the first century of our era in Northern India. Chess is believed to have been the prototype of various wars and battles, but without bloodshed, and therefore won a huge interest of the rulers of ancient states, where they could fight each other without causing a single harm to their armies [2].

There is one very ancient legend that tells us about a clever peasant. One day, he came to the king and told him about a new game. The ruler liked the game (known to us as chess) very much. But the peasant asked to fulfill one condition in return, and then he would have told more details about that game. The king agreed. The conditions were as follows: put one grain of wheat on the first checkerboard cell, two – on the second, four – on the third etc., doubling the number of grains in each next cell. The king laughed and said that he would easily fulfill this condition. Then he ordered to open the royal barn, and called the servants. Everybody started to count but they realized that it was simply impossible to fulfill this condition. There was no such amount of grains on the planet. The king did not fulfill his condition, but




the peasant was not upset, and explained the rules of the game thoroughly. As a reward, the king gave the peasant all grain supplies from the barns. The peasant divided it equally into his village. Actually, the history of chess begins with this legend [3].

Let us calculate how much grain the peasant had to receive. It is necessary to calculate the sum  $1 + 2 + 4 + \dots + 2^{63}$ . The sequence  $1, 2, 4, \dots, 2^{63}$  is a geometric progression, where  $1$  is the first term of a geometric progression,  $2^{63}$  – the term of the geometric progression,  $q = 2$  is the denominator,  $n = 64$  is the number of sequence members. Formula for finding the sum of a geometric progressions:  $S_n = \frac{b_1(q^n - 1)}{q - 1}$ . Substituting our values into the formula, we get:

$$S_{64} = \frac{1(2^{64} - 1)}{2 - 1} = 2^{64} - 1 = 18446744073709551615$$

One of the popular chess and math problems is finding the route of a knight on a chessboard. Go around all the fields of the chessboard with a knight visiting each of them only once. We will represent one of these routes graphically (pic. 1):

7	24	53	36	5	22	51	34
54	37	6	23	52	35	4	21
25	8	55	58	45	12	33	50
38	59	46	13	48	57	20	3
9	26	15	56	11	44	49	32
60	39	10	47	14	31	2	19
27	16	41	62	29	18	43	64
40	61	28	17	42	63	30	

**Pic. 1. The route of the horse**

Much more difficult is the problem of finding all routes of the knight and counting their number. Alas, this problem has not been solved yet (*perhaps, you'll succeed to solve it?*). It is known that the number of solutions

does not exceed  $C_{16}^{63}$  (the number of combinations consists of one hundred digits), but more than 30 million [1, p.22].

The problem of eight queens, like the problem of the knight's move, is one of the most famous math problems on the chessboard. If the problem of the knight was studied by Leonard Euler, the problem of queens attracted the attention of another great mathematician – Karl Gauss [1, p. 45]. How many ways can you use to place eight queens on the chessboard so that they do not threaten each other, when two figures don't stand on the same vertical, horizontal and diagonal?

To find one or another arrangement of queens that satisfies the condition of the problem is not so difficult. It is much more difficult to calculate the total number of existing constellations; in fact, this is the problem of eight queens.

Many famous mathematicians tried to solve this problem, among them are M. Bezzel, F. Nauk, V. Ahrens. Strong proof that 92 solutions exhaust all possibilities was received only in 1874 by the English mathematician D. Glasher (using the theory of determinants) [1, p. 46]. As it was mentioned before, there are 92 solutions, but there are only 12 main ones. The rest are obtained by using symmetry.

It should be noted that the mathematician F. Minding, who approached the problem with algebraic point of view, proposed a method to derive the formula for the number of all solutions. But the calculations that follow are impracticable. Therefore, Minding's method is only of theoretical interest.

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## **FAU-2: HITLER'S ROCKET THAT USHERED IN THE SPACE AGE**

**Development costing thousands of lives.** There is no exact figure for the total number of victims of FAU-2, but it is estimated that there were several thousand. In the UK alone, 2,724 people were killed in missile attacks. However, the FAU-2 production program itself claimed many more lives – at least 20 thousand.

«This fact is often unjustly forgotten», says Doug Millard, a rocket historian and curator of the Science Museum in London, which houses a copy of the FAU-2 in the main exhibition hall. – «The rockets were built at the cost of many human lives, because the Nazis used the slave labor of concentration camp prisoners» [1].

The prisoners worked in a 24-hour underground factory called Mittelwerk near the Buchenwald concentration camp in central Germany. Many prisoners with the necessary technical skills – for example, welders – were taken from other camps. Their living conditions were appalling – people were kept without sunlight, in unsanitary conditions, they were starving and lacking sleep. There have been cases of prisoners being killed for attempting to sabotage work. According to eyewitnesses, the guilty were hung on the cranes of the assembly lines.

Despite his complicity in maintaining the inhuman conditions of the workers of the Mittelwerk factory, the creator of the FAU-2, Wernher von Braun, went down in history as a genius of rocketry. The Allies recognized that the FAU-2 rocket was technologically superior to their own designs.

Thanks to its powerful engine, the FAU-2 was able to cover a

distance of about 190 km at a cruising altitude of over 80 km. The engine, powered by ethanol and liquid oxygen, represented a fundamentally new word in rocketry. In fact, the FAU-2 became the world's first space rocket.

«Small rockets have been built since the 1930s, but the FAU-2 was much larger and had a longer range», says Millard. – «She brought rocketry to a qualitatively new level» [1].

**Revolutionary technology.** One of the most revolutionary technological solutions used on the FAU-2 was the automatic guidance system, which did not require constant target designation from the ground. The coordinates of the target were entered into the onboard analog computer before launch. Gyroscopes installed on the rocket monitored its spatial position during the entire flight. Any deviation from the specified trajectory was corrected by the rudders on the side stabilizers.

Not surprisingly, after the end of the war, the United States, the USSR and Britain rushed to take over the technology for creating the FAU-2. Von Braun, who did not want to work for Stalin, surrendered to the Americans. And the Soviet Union got a missile factory and a test site [2].

«Both American and Soviet specialists took the FAU-2 apart by cogs to understand how it worked,» Millard notes. – «As a result, the Soviet Union created an exact copy of the rocket. The Americans, however, took several copies to the United States, where they used them for high-atmospheric experiments» [1].

However, in the United States they understood that technology is secondary in comparison with the genius who created it. The Americans got von Braun. And although the development of intercontinental

ballistic missiles became a military priority for Washington, the German engineer was able to simultaneously pursue his long-held dream of flying into space.

«Soon, commissioned by the US Army, von Braun began developing the Redstone missile, which was a modification of the FAU-2,» says Millard. – «The Redstone variant was used in 1961 to launch the first American astronaut, Alan Shepard, into space» [1].

**FAU-2 legacy.** Thus, it is not difficult to trace a direct connection between the FAU-2 rocket, created with the help of slave labor of prisoners of war, launched at targets from Nazi-occupied Europe, and the first American manned space flight.

«The FAU-2 technology, which later allowed the Americans to go to the moon, was developed at the cost of enormous resources, including human lives,» Millard said [2].

Was it possible to land a man on the moon without resorting to the help of Hitler's weapons? Probably yes, but it would take much longer. As with many other innovations, the war spurred work on rocket technology and accelerated the onset of the space age.

The fundamental principles behind rocketry have not changed significantly in 70 years. The design of rocket engines remains the same, most of them run on liquid fuel, and gyroscopes are still used in onboard control systems. All of these solutions were first implemented on the FAU-2 [2].

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## **DO YOU HAVE A CHANCE OF WINNING THE LOTTERY?**

There are a lot of people in the world who have tried to play the lottery at least once. In addition, very few people won a large amount of money or a valuable prize. Let us look at 4 rules that will help you win or get closer to winning the lottery:

### *Rule 1. Assess the risks.*

Now it is no secret that casinos and various gambling establishments calculate all of their games. To always have a profit. But if you win a large amount of money, it will not be the money of the organization that conducts the raffle, but the money of ordinary people who are unlucky. However, if you win a large amount of money, it will not be the money of the organization that conducts the raffle, but the money of ordinary people who are unlucky. Anyway, even the most complex mathematical models usually boil down to one thing: If you bet 1 coin, and you are offered to get 1,000 coins, then your chance of winning is less than  $1/1,000$ .

Conventionally speaking, mathematics can answer the question, which is better: a million dollars with a  $1/100,000$  chance or \$50 with a  $1/4$  chance? Intuitively, it seems that the first offer is more interesting, but mathematically the second is more profitable [1, p. 158].

If you stay within mathematics, you can calculate as follows: it is impossible to win at the casino. Any strategy you choose leads to the fact that the product of the probability of winning by the size of the

payout for the player is always lower than the bet he has already made.

*Rule 2: Play in the open.*

If you intend to play a game of chance, it is useful to understand its mechanics.

For example, the famous slot machines «One-armed bandit» are actually a bit of a trick: symbols of different values are drawn on the wheel that the player sees, but at the same time everything is arranged so that the player thinks that the chances of each symbol falling out the same [2, p. 173]. In fact, behind every visible wheel is a real one, on which precious symbols are rare and cheap ones are frequent. The odds of getting a 777 on a slot machine are lower than the probability of getting, for example, 3 cherries, and this difference can be great. «Open» lotteries are much more honest in this sense.

*Rule 3. Know your chances.*

The probability of the jackpot in any lottery is usually calculated by one formula. However, most lotteries have secondary prizes in addition to the main prize. But we will look at the jackpot for ease of evaluation.

Let us assume, we bought a lottery ticket with a random set of numbers. During the raffle, the same number of balls with numbers as in the lottery ticket is pulled out, and if the numbers on them coincide with the numbers on the ticket (in any order), then we have won. The probability of such a win is calculated as follows:

The probability of winning =  $1 \div \text{Number of ball combinations}$ .

The number of combinations without considering the order in mathematics is calculated by the formula:  $C_n^k = \frac{n!}{k! \times (n-k)!}$  [1, p. 43].

Let's consider the more complicated case — the popular

American lottery «Powerball», in which the jackpot value exceeded a billion dollars. According to the rules, there is a basic sample of 5 numbers (1 to 70), as well as one additional number (1 to 26). You should get a match for all six numbers to win. It can be calculated that the chance of getting the first set is 1 to the number of combinations at  $k = 5$  and  $n = 70$  (that is, 12,103,014), and the chance of getting the last ball is 1 to 26 [3]. To get everything immediately, these chances must be multiplied, because the events must happen at the same time:

$$(1 \div 12\,103\,014) \times (1 \div 26) = 1 \div 292\,201\,338 = 0,000000003\%.$$

In other words, if 300 million people buy tickets, only one person will win. This shows why winning the jackpot often does not happen: lottery organizers simply do not print so many tickets for the winning one to be caught.

#### *Rule 4. Start on time.*

In probability theory, there is the concept of independent events. This means that the outcome of one event does not affect the outcome of the other. For example, if you roll two dice, the falling numbers on them are independent of each other. However, if you draw two cards from the deck, these events are dependent because the first card determines which cards remain in the deck. A popular misconception about this is called — gambler's error. It arises from an intuitive idea of the dependence of independent events [3].

Going back to the lotteries: the different games are independent events, because the sequence of balls is re-selected. So, the chances of winning any particular lottery do not depend in any way on how many times you have played it before. However, buying several tickets for one game increases your chances proportionally. Because the tickets within



one game are dependent: if one wins, then the other (with a different combination) will definitely not win. Buying 10 tickets increases the odds by almost 10 times if all combinations on the tickets are different. In other words, if you have money for 10 tickets, it is more profitable to buy them for one game than to buy a ticket for 10 games [2, p.65]. Even a 1/100 probability from an individual's perspective is insignificant. If you check that probability, once a month, you can do 100 such checks in 8 years. So, always bet only an amount that you are not afraid to lose completely, so as not to be upset over the loss in the end.

In addition, remember that the theory of probability cannot be cheated.

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## **PROBLEMS OF THE SPACE X REUSABLE ROCKETS**

The relevance of my work lies in the fact that at the moment, reusable launch vehicles are gaining great popularity. In connection with these, many questions arise about this branch. In my work, I will try to answer a few of them, because there are too many of them.

The aim of the work will be to identify problems with SpaceX's reusable rockets.

Reusable spacecraft is a spacecraft, the design of which provides for the reusable use of the entire spacecraft or its main parts after returning from space flight. Sometimes the name 'shuttle' is used [2].

For the first time, the private American company SpaceX was able to re-launch a stage of a Falcon 9 rocket into space and successfully land the return carrier element on a platform in the Atlantic Ocean. According to experts, the technology of reusable spacecraft should significantly reduce the cost of space flights, and Elon Musk himself, the company's executive director, called this event a revolution in the space industry. However, can we talk about a revolution? Despite the obvious importance of this event, it is still impossible to call it a breakthrough one. The idea of reusable spacecraft inevitably comes up against the need for diagnostics and repairs, while bumping into what is called the theory of destruction in science. In modern mechanics, a holistic theory that describes the processes of destruction of materials has not been fully formulated yet, therefore, it is practically impossible to calculate accurately how this or that part will behave after a flight into space. This can lead to unforeseen consequences, which, unfortunately, will only be detected at startup. In addition, a full check of all components

and assemblies of the apparatus, and even more so their replacement, albeit partial, can result in considerable expenses. SpaceX itself does not disclose its costs for these purposes. SpaceX officials are now talking about a 10 percent discount to partners who agree to reuse the first stages. The production of most parts is automated, which means that it can be much cheaper to manufacture them from scratch than mechanical intervention and the manufacture of individual parts 'on an individual basis'. The situation is about the same as with cars and, in fact, all modern technology in general: manufacturing a device is often much cheaper and more profitable than repairing it. But, on the other hand, old parts need to be disposed of, which means that more costs will be spent on this. If the designed devices are nevertheless so reliable that the need for diagnostics and expensive repairs really disappears, this will become a truly serious success. If the same stage can fly into space at least twice, this will significantly reduce the cost of the flight. However, how can this be achieved? The reliability of the apparatus can be raised by increasing the safety margin, which naturally increases the mass of the entire apparatus, which automatically entails a decrease in the mass of the payload delivered to orbit. In addition, to return the steps, you need to carry with you additional units, which also weigh a lot. Thus, the mass of the payload delivered to low orbit on a Falcon 9 rocket with a return stage is 13 tons, while without a return stage it is 22. Thus, the safety margin required for reusable use kills the very idea of a low cost of delivering cargo to orbit, since the mass of the payload becomes too low [1].

In a word, the idea of reusable spacecraft, despite the excitement caused by the launch of Falcon 9, carries certain prospects, but fraught with a lot of unresolved issues by modern science [1].

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## **STATISTICS IN SCIENCE AND BUSINESS**

Statistics is one of the most requested and widely used specialties today. Specialists in this field will find application of their knowledge in any country and region. The scope of statistical data analysis is so wide that it covers many industries – from services to medical and space research.

Statistical methods help to correctly perform predictive modelling and interpret its results, which allows to learn important information for the company and determine the best strategy for promoting the product on the market, highlight the most important features of the product and get the expected result [2]. Any company creates a development strategy and plans its production processes. One of the graduates of the Department of Statistics and Probability Theory of Oles Honchar Dnipro National University describes his work as an analyst of a retailer: «The main tasks in my position are conducting a comprehensive study of the domestic market of goods to reduce commodity costs in production and assess the competitiveness of goods, as well as develop proposals to improve and optimize product range» [3]

The most important role in the modern world is given to information. It is statistics that allows collecting, analysing and processing information correctly. Timely and correctly systematized data allows drawing necessary conclusions. Statistics, closely intertwined with Data Science and Computer Science, helps to quickly analyse all the key features of obtained information and ways to solve related

problems, depending on the desired result. In any area of business, any company collects, processes and stores information: personal data, financial statements, economic indicators and other. For example, consider the issue of safety, which is a priority in every organization of each production process. State policy in the field of labour protection is based on the principles of priority of employees' life and health, full responsibility of the employer for the creation of appropriate, safe and healthy working conditions. The collection and accumulation of statistics concerning the level of workers' injuries at work and occupational diseases allows identifying and analysing possible risks associated with working conditions, in order to minimize or eliminate their negative consequences for employees and production [1, 3].

Another example is the market analysis of suppliers and services, monitoring the value of goods and services to optimize the purchase of raw materials. Proper processing and systematization of this data can significantly reduce costs and use time in the most efficient way. The importance of forecasting and planning the company's development strategy should not be underestimated. An integral part of the forecasting process is the statistical collection, processing and analysis of data. Business models built on the basis of the forecast allow to make timely decisions aimed at stable development of the enterprise and to plan the company's activities correctly.

Another practical application of the information collection and statistical processing is the selection of proposals for the goods and services sales on the Internet. One of the graduates of the Department of Statistics and Probability Theory of Oles Honchar Dnipro National University, who holds the position of Python Developer in an IT company,

comments this aspect of his activity: «At work, we are personalizing and developing recommendation systems for online stores. We mainly use the Python programming language and the SQL query language. We also worked a bit with R. It turns out to be very interesting». [3]

Statistics has penetrated so deeply into all spheres of human activity that it is difficult to list all cases of its use, as well as to assess its significance - this science is the basis of normal activity in every field, an integral part of doing business and so on. The above examples are only a very small proportion of its applications, which proves that statistical methods are used anywhere in human life and professional activity.

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