ARTIFICIAL INTELLIGENCE AND ACCOUNTING IN THE DIGITAL ECONOMY

INTELIGENȚA ARTIFICIALĂ ȘI CONTABILITATEA ÎN ECONOMIA DIGITALĂ

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Summary: *In the digital economy, information systems are rapidly changing, this also applies to accounting programs. The use of artificial intelligence systems has become widespread in various sectors of the classical economy: transport, trade, industry, banking and financial sectors, medicine, space technology. The use of artificial intelligence systems in the processing of a large volume of accounting databases, as example: processing of large volume of invoices have already become a reality. Artificial intelligence in the field of accounting can not only process data, prepare financial statements, but also provide information security, can communicate in natural language, etc. The current environment orders an accountant to remain in the ranks of high performed specialist, he simply needs to rebuild his thinking, improve his level of knowledge in the field of artificial intelligence, and more rapidly adapt to the new requirements of the digital economy.*

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Introduction

Soon, accounting is expected to undergo major changes associated with blockchain technology and the expansion of the use of artificial intelligence systems.

The first definition of artificial intelligence was given by John McCarthy in 1956 at a conference at Dartmouth University. However, there are different points of view on the definition of artificial intelligence. So, for example: A. N. Averkin, M. G. Gaaze-Rapoport, D. A. Pospelov in the dictionary on artificial intelligence note that the artificial intellect is « *scientific direction, within the framework of which the tasks of hardware or software modelling of those types of human activity, which are traditionally considered to be intellectual, are set and solved »*[6]. Professor Gennady Osipov, President of the Russian Association of artificial intelligence claims that the A.I is a «*direction in computer science and information technology, whose task is to recreate with the help of computer systems and other artificial devices reasonable reasoning and actions»*[7].

According to the definition of Andreas Kaplan and Michael Henlein, artificial intelligence is « *the ability of the system to interpret external data correctly, to learn from such data and to use the acquired knowledge to achieve specific goals and objectives through flexible adaptation »*[8].

According to the authors: the concept of artificial intelligence is much broader than the definitions presented, this concept covers almost all areas of knowledge and human life. ***This is an area of scientific and practical human activity aimed at creating artificial systems capable of solving intellectual problems.*** In this regard, it is necessary to determine the approaches and tasks of artificial intelligence.

Should be noted that J. Copeland[9] in the creation of intelligent information systems, identifies two main approaches to their development:

Top-Down AI, (aka symbolic) approach –

- Hierarchically organised (top-down) architecture
- All the necessary knowledge is pre-programmed, i.e. already present - in the knowledge base.
- Analysis/ computation involves creating, manipulating and linking symbols (hence propositional and predicate- calculus approach).
- ``Serial executive'' might be the conscious rule-interpreter which acts on the parallel-processing unconscious intuitive processor.
- Thus, the program performs better at relatively high-level tasks such as language processing aka NLP - it is consistent with currently accepted theories of language acquisition which assume some high-level modularity. But how well are subtleties of language handled?

Bottom-Up AI, neural networks –

- Models are built from simple components connected in a network.
- Relatively simple abstract program consisting of learning cycles.
- Program builds its own (distributed) ``knowledge base'' and ``common sense assertions''.
- Normally done with parallel processing, or more commonly with data structures simulating parallel processing, such as neural networks.
- "... intelligence emerges from the interactions of large numbers of simple processing units" (Rumelhart et al., 1986 - PDP, vol. 1, p. ix)
- Closer relation to the known microstructure and functioning of the brain, thus might allow for more explicit modelling. See brain analogy later.
- Built-in learning mechanism, thus adaptivity and flexibility. See cognition analogy later.
- Better able to model lower-level human functions, such as image recognition and motor control - hence robotics, computer vision and speech recognition.

There are several stages in the creation of artificial intelligence:

    1) symbolic,
    2) logical,
    3) agent-oriented,
    4) hybrid.

Historically, the symbolic approach was the first in the era of electronic machines, since it was after the creation of Lisp, the first language of character computation, that its author became confident in the possibility to practically start implementing these means of intelligence.

The success and effectiveness of solving new problems depends on the ability to allocate only essential information, which requires flexibility in methods of abstraction. The main feature of symbolic computation is the creation of new rules during program execution. While the capabilities of non-intelligent systems are completed just before the ability to at least denote emerging problems.

Logical approach the creation of artificial intelligence systems is based on the modelling of reasoning, which is based on logic.

The logical approach can be illustrated using the language and the system of logical programming *prologue*. Programs written in the *prologue language* represent sets of facts and rules of logical inference without a hard task of the algorithm as a sequence of actions leading to the desired result.

Agent-based approach began to develop since the early 1990s, is an approach based on the use of intelligent (rational) agents, which is a computer that perceives the world around it by means of sensors and can affect objects in the environment by means of actuators.

This approach focuses on those methods and algorithms that will help the intelligent agent to survive in hybrid approach:

The hybrid approach suggests that a synergistic combination of neural and symbolic models achieves a full range of cognitive and computational capabilities. For example, inferences can be generated by neural networks, and generating rules are obtained by statistical training.

It should be noted that currently certain artificial intelligence systems operate in various sectors of the economy. The following figure provides examples of such industries.
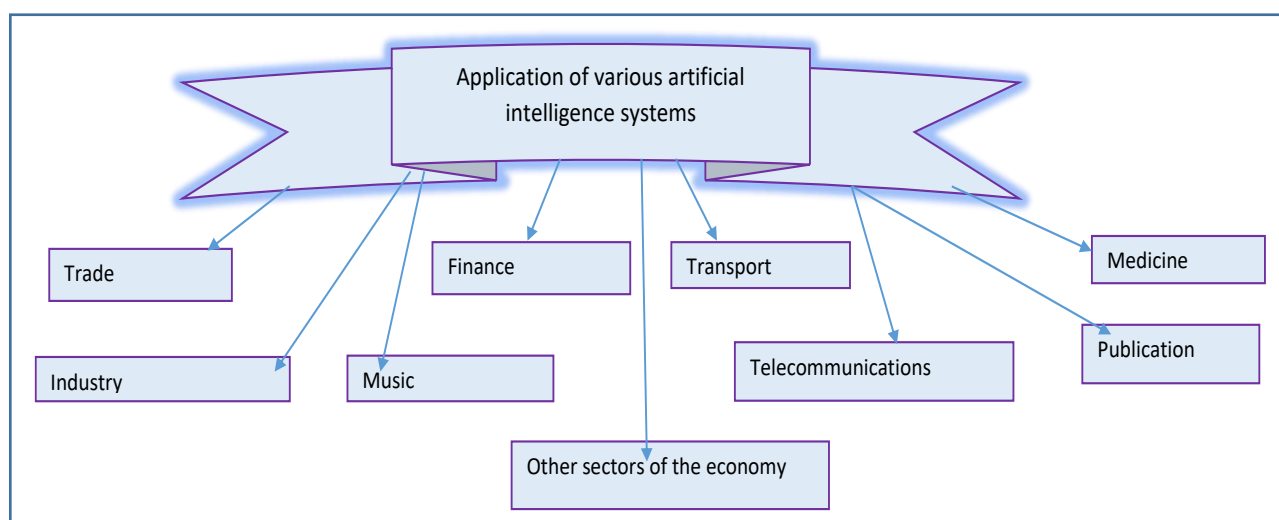
Img.1 Industries in which various artificial intelligence systems operate

Source: developed by the authors based on the literature in the field of artificial intelligence

In *trading*, if we talk about algorithmic trading, complex artificial intelligence systems are used to make trading decisions at a speed exceeding the speed at which a person is capable, which allows you to make millions of transactions a day without his intervention.

In the field of *Finance*, artificial intelligence systems operate under:

- ✓ portfolio management investment,
- ✓ data mining market research,
- ✓ personal finance management,
- ✓ underwriting.

Financial portfolio management is that automated systems provide financial advice to create and manage a financial portfolio with minimal human intervention. This class of financial advisors works based on algorithms designed to automatically develop the financial portfolio in accordance with the investment objectives and risk appetite of clients. Automated systems monitor changes in financial instruments on the market in real time and make up an investment portfolio in accordance with the wishes of the client

Market research and data mining. It should be noted that a number of large financial institutions use artificial intelligence systems BlackRock' AI, Aladdin, which have a wide range of functionality, namely: the processing of natural language for reading text: broker reports and social networking information; assessment of the situation. In the financial system, banks such as UBS and Deutsche Bank use the artificial intelligence system Sqreem, which can process data to develop profiles of consumer investments and match them with products that they are likely want to purchase. Various market Analytics platforms are also used, for example: Kenshi, which combines statistical computing with big data and natural language processing.

Different applications are used to manage personal finances, for example: Digit, based on artificial intelligence, which automatically helps people to optimize their expenses and income, based on their personal habits and goals. The application analyses the monthly income, current account balance and expenses, then makes its own decisions and transfers the money to a separate savings account.

For underwriting purposes, the following systems are used: Upstart, a ZAML platform that is used specifically for credit underwriting. This platform uses computer training to analyse tens of thousands of traditional and non-traditional variables (from purchase transactions to how the customer fills out the form) used in the credit industry to evaluate borrowers.

Artificial intelligence systems are widely used in transport: automatic transmissions based on fuzzy logic (used in cars: Audi TT, VW Touareg, VW Caravell, Škoda Fabia) also currently includes a controller based on fuzzy logic. Currently, the samples of the unmanned vehicle have already been developed, for example: in 2008, General Motors announced plans to start testing the unmanned vehicle in 2015 and the possible launch of the product to the market by 2018, in Japan on December

14, 2016. Kota passed the first tests of an unmanned vehicle on a stretch of highway length of 700 meters, open to the movement of other cars. The main problem for the development of this artificial intelligence in transport is the fact that transport systems are inherently complex systems that include a very large number of components and different sides, each of which has different and often contradictory goals.

In the field of medicine, the following systems and technologies of Concept Processing work in ESRI software, they are used as clinical decision-making systems for medical diagnosis, as assistants for nursing the elderly, etc.

Artificial intelligence systems, namely robots, work in industry, in jobs that are considered dangerous to humans or are associated with repetitive routine tasks that can lead to errors or accidents due to reduced concentration over time. In 2014, China, Japan, the United States, the Republic of Korea and Germany together accounted for 70% of global robot sales. In the automotive industry, a sector with a particularly high degree of automation, Japan had the highest density of industrial robots in the world: 1,414 robots per 10,000 employees.

In the field of music, artificial intelligence creates symphonies of classical music for films, for example: such a system as AIVA (Artificial Intelligence Virtual Artist), becoming the first virtual composer to be recognized by the music professional Association. Artificial intelligence can even create music suitable for medical use, Melomics uses computer music to relieve stress and pain.

Considering the use of artificial intelligence and telecommunications, we can state the following: currently, there are various systems for customer service such as:

- Inbenta, which is focused on the development of natural language, that is, understanding the meaning of what is being asked, rather than just analysing the words used, understanding the context and producing a response in natural language. One of the elements of Ibenta customer service has already been achieved is the ability to automatically respond to and respond to e-mail requests,
- Digital Genius explores a database of information (from past conversations and frequently asked questions) and provides tips to customers to help them more effectively address queries.
- IPSoft is creating technology and emotional intelligence for adaptation of customer interaction. The answer relates to the tone of the client so that he can show sympathy.

For publishing, several companies such as Echobox have developed software that helps publishers increase traffic by "intelligently" posting articles on social media platforms such as Facebook and Twitter. By analysing large amounts of data, artificial intelligence learns how specific audiences respond to different articles at different times of the day. Similarly, Automated Insights generates personalized summaries and previews for Yahoo Sports Fantasy Football. SAP uses artificial intelligence to turn structured data into intelligent comments and recommendations in natural language. Yseop can write financial reports, Executive summaries, personalized sales or marketing documents, and more at thousands of pages per second and in multiple languages, including English, Spanish, French, and German.

In other industries, artificial intelligence manages human resources, such as viewing resumes, ranking candidates according to their skill levels, and creating chatbots that can automate repetitive communication tasks. Various means of artificial intelligence are widely used in the field of security, speech and text recognition, data mining, gesture recognition (understanding sign language machines, facial recognition for the interpretation of emotions and non-verbal signals, robotic navigation, overcoming obstacles and recognition of objects, etc.).

There are great opportunities for artificial intelligence in the field of accounting. For example: FreeAgent, a software manufacturer, reviewed "Future of Accounting" and concluded that 96% of respondents believe that all or a significant part of the work of accountants will be automated in the UK by 2022. At the same time, it should be noted that accountants, as well as other financial workers, should respond flexibly to the challenges of the digital economy, this applies not only to the study and application of new technologies such as blockchain, artificial intelligence and automation of robotic processes. However, non-technical skills such as cognitive flexibility, people management

and coordination with other parts of the enterprise should also be considered. Artificial intelligence for accounting purposes recognizes documents, indexes them, determines the overall meaning of the request and their content, extracting the right of hundreds of millions of pages.

Example of a work platform ABBYY FlexiCapture, which digitalize accounting processes and financial controls. The technology automatically extracts and verifies data from any payment documents: more than 2.6 million pages per year. For example, an employee of the company "MOEK" thanks to this platform, can conduct any transaction remotely by scanning a paper document. It should be noted that in the company such solutions are used by more than 2 thousand employees, while the company "MOEK" makes quarterly financial statements 3 times faster – in just 10 days. ABBYY FlexiCapture platform developments are used by such companies as Volkswagen, Pepsico, Raiffeisenbank, Rosneft, PwC and others.

An important feature of the development of the digital economy is the emergence of open systems that implement open standards for interfaces, services and data formats enough to ensure:

- ability to transfer application systems designed properly with minimal changes to a wide range of systems;
- collaboration with other application systems on local and remote platforms;
- user interaction and mobility.

The emergence of web services is a means of integrating various applications. The openness of information systems is achieved through the development of standards for their interaction, however, it should be noted that by the beginning of the XXI century more than 700 standards were published and only the implementation of the standard TCP/IP, developed at the University of California, was the beginning of a new stage – the emergence of real compatibility of independently developed software components running on different computers in different operating systems. The use of open systems can be called the work of the "collective mind".

Processing of data including an accounting data ca be passed in 3 stages:
1. Processing on local computers, (database),
2. Online data processing (OLAP-on-line Analytical Processing),
3. Data mining (data Mining - DM).

Especially promising today is a combination of data warehouses (Data Ware House) and DM-technologies, as they do not function according to previously specified formulas, but based on functional dependencies corresponding to the accumulated data.

In DWH+DM-technologies the following tools are used in various combinations: neural networks, genetic algorithms, process visualization tools, decision tree generation methods, statistical analysis methods. Modern achievements of information technologies are decision support systems (Electronic Performance Support Systems-EPSS) and multi-agent systems (MA). The first is designed to provide for joint use of expert analytical systems and control systems. The latter solve the problem of parallel processes organization in distributed user systems.

Currently, specialized software tools have been developed to support management decisions at different levels of management. Thus, at the operational level, the concepts of SCM (supply chain management), MRP (production management), CRM (customer relationship management) are applied. At the tactical level of management software products of class BI (business Analytics), Project Expert (innovative design) are used. For accounting and analytical support of strategic level of management dashboards balanced scorecard BPM/BSC (Business Performance Management), and so on.

Advances in the field of Informatics, Cybernetics and information technologies make it possible to significantly remove restrictions on the complexity of accounting operations, processing of statistical data sets, change approaches to the processes of storage, transmission and aggregation of economic, including accounting information.

Increasing the speed of information processing, and the amount of necessary RAM, the use of network technologies expands the ability of accountants on the frequency of reporting, increase the levels of Analytics, the introduction of regulatory indicators in the accounting program. The use of specialized

software creates real prerequisites for the study of the relationship of accounting with the methods of linear algebra and computer modelling.

During the operation of the accounting system will be collected, coded, stored information in the form of a knowledge base consisting of descriptions, relationships and procedures related to accounting, management, economic analysis, audit, statistics. The system should also be able to perform complex classes of tasks such as interpretation, diagnostics, debugging, design, planning, monitoring, instruction, and clarification and extension of knowledge by automatically identifying new knowledge.

The simplest artificial intelligence system works as an exhaustive search engine using monotonic reasoning in the opposite direction, supplemented by a numerical heuristic combinational function that allows ranking competing hypotheses. Such a system can cope with the tasks of diagnosis and interpretation of limited complexity. Other systems use more sophisticated tools as the tasks are more complex – for example, the task of understanding speech, image recognition, planning experiments.

"Intelligent" information technologies can be applied in many accounting tasks, for example: changes in accounting policy, changes in various indicators or regulations. A modern solution to the problem of storing economic information and ensuring its security are "cloud" technology – information processing technology, a feature of which is that computer resources and power are provided as an Internet service, and the software is leased. To use it enough to have access to the Internet. Work "in the cloud" significantly reduces the company's costs for computer support.

We propose an algorithm for the modification of accounting policies by the artificial intelligence system.
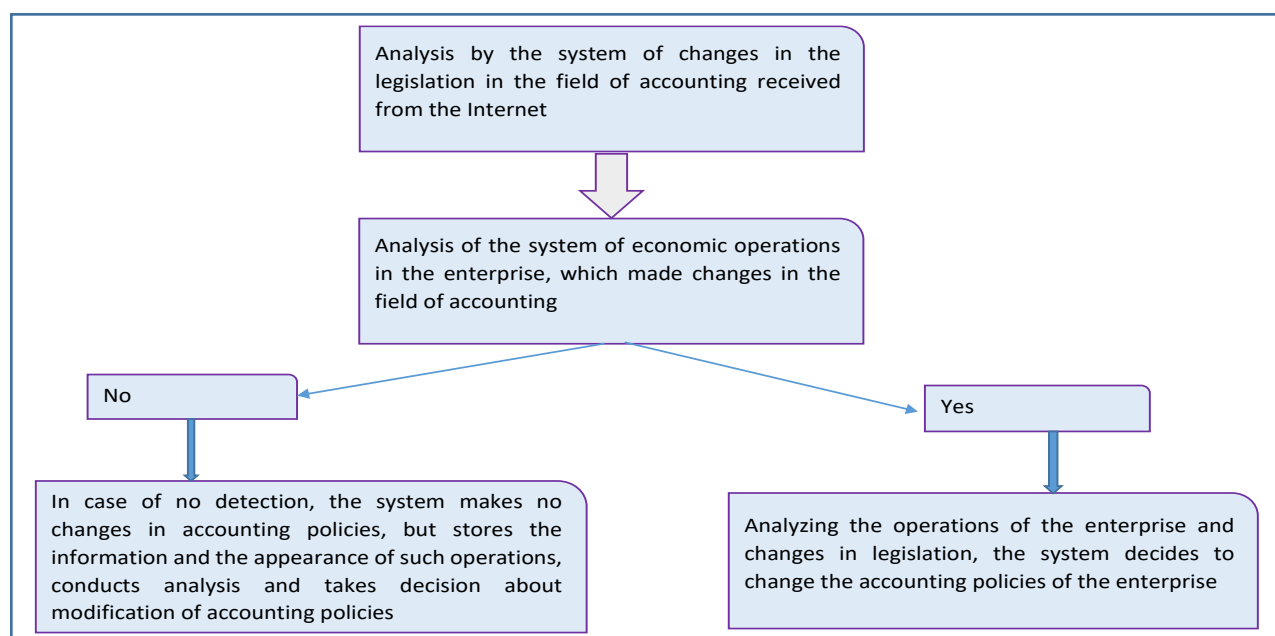
Img.2 The proposed algorithm of modification of accounting policies of the enterprise when changing the legislation in the field of accounting, carried out by artificial intelligence systems

Source: developed by the authors

Requirements for information accounting systems are constantly growing, not only because the volume of information and data that need to be processed efficiently and on time, but also because there is a need to help the accountant in the analysis of various types of information: changes in legislation, decision-making on accounting policies, etc.

In the digital economy, accounting software must meet certain requirements:

- it is an open system that can be freely integrated with the systems of business partners, banks, tax authorities and other government agencies;
- use the ability to store credentials in cloud storage;
- have a logical structure of the construction of the type of artificial intelligence.

Only such an information system can become a truly powerful tool that will raise the organization of accounting to a very high level. Artificial intelligence systems are also used in auditing. For example: auditing company Raedan uses an online platform Xero integrated with Receipt Bank, which allows based on artificial intelligence technology, using the forecasting tool Fluidly to evaluate the cash flows of customers, and for analysing and processing costs from customers, a system Expensify. The main advantage of artificial intelligence is that can process huge amounts of information in the shortest possible time. This means that in the future it will be able to prepare various reports and do it as soon as possible. Artificial intelligence systems work effectively in various studies, allowing you to collect and analyse data ten times faster. It is worth noting that the largest audit and financial companies have already adopted the AI system. We are talking about various programs and applications that use artificial intelligence and cognitive technologies to perform certain calculations and data analysis. Such technologies are still used to solve narrow problems, but the range of their capabilities are expanding every year.

Conclusions

In conclusion, it should be noted that after studying the information about artificial intelligence, the authors first analysed the definition of this phenomenon. The authors are concern about the concept of artificial intelligence is much broader than the definitions of other authors presented in the article, this concept covers almost all spheres of knowledge and human life. Thus, according to the authors: artificial intelligence is a field of scientific and practical human activity aimed at creating artificial systems capable of solving intellectual problems. Analysing applications of artificial intelligence, it is possible to ascertain their global use from music to transportation, from space technology to medicine. The fact that soon artificial intelligence will be used in information accounting systems is not far off. Therefore, the accountant who works in a digital economy will have great demands associated with understanding and working with artificial intelligence systems.

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