UDC 0.04+530
DOI https://doi.org/10.32782/pet-2024-1-8

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To cite this article: Trokhimchuck, P., Vilihurskyi, O., Zamuruieva, O., Sakhnyuk, P., Ivanovsyi, A. (2024). Osnovni problemy rozvytku kompiuternykh nauk ta neobkhidnist vkliuchennia fizychnykh protsesiv [Main problems of development the computer science and necessity of the application of physical processes]. *Physics and Educational Technology*, 1, 63–73, doi: https://doi.org/10.32782/pet-2024-1-8

MAIN PROBLEMS OF DEVELOPMENT THE COMPUTER SCIENCE AND NECESSITY OF THE APPLICATION OF PHYSICAL PROCESSES

The problems of evolution the cybernetics and computer science are analysed. Short historical analysis of this problem is represented. It includes Greek abacus and the Peruvian system of nodal counting. The role of Blaise Pascal and Wilhelm Leitzbnitz in establishing the foundations of computer science is noted. The next stage in the development of computer science was the research of Charles Babbage and Lady Ada Lovelace. It was Ada Lovelace, who initiated the programming procedure. The concept of cybernetics as the management of ships originated in Greece. In the 19th century, it was formulated as a science of management by J. Ampere and B. Trentowski. It was completed by N. Wiener, according to whom cybernetics is the science of control in the living and non-living world. Later, cybernetics became the basis of computing. In its bowels, the theory of automatic regulation was expanded and the foundations of modern information theory were formulated. As F. George showed, cybernetics is a synthetic science that includes a number of sciences that are needed to solve the relevant problem. Research has been conducted on the development of the hardware base of modern cybernetics and computer science: from pebbles, nodules and bones to modern optoelectronic systems. Modern computer science has a somewhat broader meaning as defined by N. Wiener. The main task of modern computer science is the formalization of the thesis of the Canadian philosopher L. Hall "Everything that comes from the head is intelligent". In this case, along with the elementary base, programming received significant development. Along with narrow-profile programming languages (Fortran, Pascal), the system programming languages C and cross-hierarchical programming (Python have been created). The structure of computer science has also changed significantly. The further development of computer systems is obviously related to the reduction of time and simplification of the procedure for obtaining the necessary information and including the real physical processes in the procedure of computation. Possible ways of implementing this are also discussed.
***Key words:** cybernetics, computer science, evolution, hardware, software, polymetrical analysis, Python.*

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Бібліографічний опис статті: Трохимчук, П., Вілігурський, О., Замуруєва, О., Сахнюк, П., Івановський, А. (2024). Основні проблеми розвитку комп'ютерних наук та необхідність включення фізичних процесів. *Фізика та освітні технології*, 1, 63–73, doi: https://doi.org/10.32782/pet-2024-1-8

ОСНОВНІ ПРОБЛЕМИ РОЗВИТКУ КОМП'ЮТЕРНИХ НАУК ТА НЕОБХІДНІСТЬ ВКЛЮЧЕННЯ ФІЗИЧНИХ ПРОЦЕСІВ

Аналізуються проблеми еволюції кібернетики та інформатики. Подано короткий історичний аналіз цієї проблеми. Сюди входить грецька рахівниця, перуанська система підрахунку вузлів. Відзначається роль Блеза Паскаля і Вільгельма Ляйбніца у створенні основ інформатики. Наступним етапом у розвитку інформатики стали дослідження Чарльза Беббіджа та леді Ади Лавлейс. Саме Ада Лавлейс ініціювала процедуру створення програмування. Поняття кібернетики як управління кораблями виникло в Греції. У 19 столітті вона була сформульована як наука про управління Дж. Ампером і Б. Трентовським. Його завершив Н. Вінер, згідно з яким, кібернетика – це наука про управління живим і неживим світом. Пізніше кібернетика стала основою обчислювальної техніки. В її надрах було розширено теорію автоматичного регулювання та сформульовано основи сучасної теорії інформації. Як показав Ф. Джордж, кібернетика є синтетичною наукою, яка включає ряд наук, необхідних для розв'язання відповідної проблеми. Проведено дослідження щодо розвитку апаратної бази сучасної кібернетики та інформатики: від камінчиків, вузликів і кісток до сучасних оптоелектронних систем. Сучасна інформатика має дещо ширше значення за визначенням Н. Вінера. Основним завданням сучасної інформатики є формалізація тези канадського філософа Л. Холла «Все, що йде від голови, є розумним». При цьому поряд з елементарною базою значний розвиток отримало програмування. Поряд з вузькопрофільними мовами програмування (Fortran, Pascal) були створені мови системного програмування Сб С++ і міжієрархічного програмування (Python). Значно змінилась і структура комп'ютерних наук. Подальший розвиток комп'ютерних систем, очевидно, пов'язаний зі скороченням часу та спрощенням процедури отримання необхідної інформації і включення реальних фізичних процесів у процедуру обчислення. Також обговорюються можливі шляхи її реалізації.

***Ключові слова:** синтез, кібернетика, інформатика, штучний інтелект, системний аналіз, поліметричний аналіз, принцип Моісеєва, Пайтон.*

Introduction. When delving into the core issues of evolution in cybernetics and computer science, we must consider several key aspects: computation problems, the organization of these calculations, and the potential applications thereof. These facets are intricately linked to the level of civilization's development throughout history, persisting to varying degrees across epochs. Hence, our exploration of the evolution of cybernetics and informatics will be anchored in this perspective.

A concise historical examination is imperative, encompassing a wide array of civilizations such as Ancient Egyptian, Sumerian, Indian, Chinese, and others. This journey traverses mythological narratives, Pythagorean theories, Plato's philosophical constructs, as well as practical systems like the Greek abacus and the Peruvian nodal counting system [Trokhimchuck, 2021; History, 2023].

Acknowledgment is due to Blaise Pascal and Wilhelm Leitzbnitz for their seminal roles in laying the groundwork for computer science. Their contributions, highlighted in various sources [Trokhimchuck, 2021; George, 1976], set a crucial precedent.

Following in the footsteps of computer science pioneers, Charles Babbage and Lady Ada Lovelace embarked on groundbreaking research, with Lovelace's introduction of programming procedures marking a significant milestone in this narrative [George, 1976].

The genesis of cybernetics, initially conceived as ship management in Ancient Greece, evolved into a formal science in the 19th century, notably formulated by F.-M. Ampere and B. Trentowski [Trokhimchuck, 2021; Computing, 2023]. N. Wiener further elaborated on cybernetics, defining it as the science of control in both living and non-living systems [Trokhimchuck, 2020; Trokhimchuck, 2021]. This discipline later formed the foundation of computing, nurturing the growth of automatic regulation theory and modern information theory. As elucidated by F. George [5], cybernetics emerges as a synthetic science, amalgamating various disciplines necessary to tackle pertinent problems.

Research efforts have been dedicated to the hardware evolution of modern cybernetics and computer science, spanning from rudimentary materials like pebbles, nodules, and bones to contemporary optoelectronic systems [Trokhimchuck, 2021, History, 2023].

Modern computer science, as articulated by N. Wiener [Trokhimchuck, 2021], encompasses a broader spectrum of meanings. Its primary objective lies in formalizing the thesis of Canadian philosopher L. Hall, asserting that "Everything that comes from the head is intelligent" [Trokhimchuck, 2020; Trokhimchuck, 2021]. This evolution has significantly advanced programming, evident in the development of specialized languages like Fortran and Pascal [History, 2023], alongside system programming languages such as C and cross-hierarchical programming like Python [Zamuruyeva, 2018; Zamuruyeva, 2020].

The structural landscape of computer science has undergone significant transformations, closely linked to the quest for reduced time and streamlined procedures in acquiring necessary information [Trokhimchuck, 2021]. Potential implementation avenues for these advancements are also under discussion.

Main Results. The roots of computer science extend far back in history, often manifesting in disciplines like mathematics and physics long before the formal establishment of the field [History, 2023]. These early developments, ranging from mechanical inventions to mathematical theories, laid the groundwork for what we now recognize as computer science. This progression ushered in a major academic domain, significant technological leaps across the Western world, and the foundation of a global trade and cultural exchange network.

An exploration into the evolution of computing methods and systems inevitably commences with ancient civilizations [Trokhimchuck, 2021]. In Ancient Egypt, for instance, the groundwork for algebraic principles was laid, alongside the creation of a universal coded system of calculations known as the tablet of the god Thoth [Trokhimchuck, 2021]. This tablet, attributed to the deity Thoth, played a pivotal role in teaching Egyptians counting, writing, and agricultural practices, akin to a rudimentary form of computational instruction.

Ancient Sumer contributed significantly to early computational knowledge, with developments ranging from spherical geometry and astrology to matrix arithmetic and the invention of the abacus [Trokhimchuck, 2021]. The abacus, in particular, emerged as the earliest known computational tool, originating between 2700 and 2300 BCE.

Sumerians devised a primitive form consisting of successive columns, delineating orders of magnitude within their sexagesimal number system. Initially employed with pebbles on sand-drawn lines, the abacus has evolved into more modern iterations, including the Chinese abacus still utilized today [Trokhimchuck, 2021; History, 2023].

In the 5th century BC, Ancient India witnessed the remarkable feat of the grammarian Pāṇini, who meticulously crafted the Sanskrit grammar into 959 rules encapsulated within the Ashtadhyayi. Pāṇini's work was characterized by its high degree of systemization and technical precision, employing metarules, transformations, and recursions [History, 2023].

The renowned phrase "Numbers rule the world" is attributed to Pythagoras, whose school delved deeply into numerical concepts. The Pythagorean tradition, serving as a nexus between various ancient systems, synthesized elements of the esoteric Egyptian rituals with the more overt traditions of Sumer and India [Trokhimchuck, 2021]. German archaeologists in 1980-8 uncovered cities featuring octagonal and semi-octagonal structures, dating back to the 6th – 5th centuries BC, possibly indicating the presence of the enigmatic Pythagoreans [Trokhimchuck, 2021].

Plato, the eminent philosopher, held mathematics in high regard, emphasizing its significance in his philosophical framework. His categorization of numbers marked an early attempt to systemize existing knowledge through mathematical principles. According to Plato, numbers could be classified into three types: mathematical (representing pure mathematics), sensory (applied mathematics), and ideal (pertaining to numerology and the numerical encoding of information, from a modern perspective) [Trokhimchuck, 2020; Trokhimchuck, 2021].

The classifications of Aristotle and Euclid played a significant role in the development of modern science. Thanks to Aristotle, the classification of modern sciences began and the foundations of formal logic were developed, which was the completion of the works of Socrates and Plato [Trokhimchuck, 2021]. From this point of view, formal logic can be considered formalized rules for conducting a dispute. Euclid first classified mathematical disciplines and created an axiomatic method of their description, which is practically relevant in successful mathematics [Trokhimchuck, 2021].

The establishment of science was significantly influenced by the organizational structure of the Alexandria Museum, founded in Alexandria, Egypt by a confidant of Alexander the Great [Trokhimchuck, 2021]. Spanning from the 3rd century BC to the 4th century AD, this institution served as a bastion for the advancement of Hellenic culture, fostering scientific development along the philosophical lines delineated by Plato and Aristotle, the latter being a mentor to Ptolemy [History, 2023].

An early marvel of mechanical ingenuity, the Antikythera mechanism, is believed to have functioned as an analog computer, facilitating astronomical calculations. Discovered in 1901 amidst the wreckage off the Greek island of Antikythera, this device has been dated to approximately 100 BC [History, 2023].

The legacy of the Alexandria Museum found continuity within the Muslim world, spanning regions such as the Baghdad Caliphate, Merage, Morocco, Cordoba, and Granada [Trokhimchuck, 2021]. Islam, under the teachings of Mohammed, advocated for universal learning, fostering an environment more conducive to scientific inquiry compared to medieval Christianity. It was during the Renaissance that these traditions experienced a resurgence within Christian territories, partly due to the Crusades and cultural exchanges with the Islamic world [Trokhimchuck, 2021]. Notably, Greek Alexandrian manuscripts were translated into Latin not directly from Greek but via Arabic translations [Trokhimchuck, 2021].

The resurgence of mechanical analog computing emerged in the medieval Islamic world, where Muslim astronomers such as Abū Rayhān al-Bīrūnī and Jabir ibn Aflah developed intricate devices like the mechanical geared astrolabe and the torquetum [History, 2023]. Additionally, Muslim mathematicians made significant strides in cryptography, including advancements in cryptanalysis and frequency analysis attributed to figures like Alkindus. Further innovations included programmable machines like the automatic flute player, attributed to the Banū Mūsā brothers [History, 2023].

The early exploration of cybernetic principles saw the contributions of notable figures such as Su Song, Heron of Alexandria, and Ctesibius, with the latter credited for inventing the first artificial automatic control system in the form of a water clock [History, 2023]. However, it was in Europe where the foundations of modern computing science and its ideological underpinnings were further developed [Trokhimchuck, 2021; History, 2023].

Remarkable advancements in mechanical engineering emerged in the 12th century with the construction of the first mechanical robot capable of articulating basic words by R. Bacon [Trokhimchuck, 2021]. Subsequently, in 14th century Europe, technological artifacts of comparable complexity emerged, exemplified by the creation of mechanical astronomical clocks [History, 2023].

The advent of logarithms by John Napier in the early 17th century marked a significant milestone, prompting a surge in innovation among inventors and scientists in the realm of computational tools. In 1623, Wilhelm Schickard conceived a calculating machine, although his project was tragically thwarted by a fire in 1624 [History, 2023]. Blaise Pascal continued this trajectory by designing a mechanical adding device circa 1640, inspired by the work of the ancient mathematician Hero of Alexandria [History, 2023]. Gottfried Wilhelm Leibniz furthered these endeavors with the invention of the Stepped Reckoner in 1672, culminating in its completion in 1694 [History, 2023].

The 17th century witnessed the formulation of foundational rules for constructing theories, exemplified by Descartes' method and Newton's four rules of inference in physics, akin to the procedure of Euclidean axiomatization [Trokhimchuck, 2021]. This development facilitated the realization of R. Bacon's assertion that "science is as much science as there is mathematics in it" [Trokhimchuck, 2021].

Charles Babbage stands out as a pivotal figure in the annals of computing history, often hailed as one of its earliest pioneers [George, 1976]. Beginning in the 1810s, Babbage conceived a vision of mechanized computation, leading to the design of a calculator capable of computing numbers up to 8 decimal points in length [George, 1976]. Expanding on this concept, Babbage envisioned a machine capable of computing numbers with up to 20 decimal places, culminating in his proposal for the "Analytical Engine" by the 1830s [George, 1976]. This visionary device, utilizing punched cards for arithmetical operations and employing sequential control, represented the first true manifestation of the modern computer [George, 1976].

Ada Lovelace, also known as Augusta Ada Byron, is acclaimed as the trailblazer of computer programming, esteemed for her mathematical prowess. Collaborating with Charles Babbage as his assistant during his endeavor with the "Analytical Engine," the first mechanical computer, Lovelace made significant contributions to the nascent field [George, 1976]. Notably, she devised the first computer algorithm, capable of computing Bernoulli numbers, although the precedence of algorithm design is subject to debate, as Babbage had earlier designed the difference engine and corresponding algorithms based on differences [George, 1976]. Additionally, Lovelace foresaw the future capabilities of computers, envisioning them not only as calculators but also as manipulators of symbols, whether mathematical or otherwise. Despite her untimely passing before witnessing the fruition of her ideas, Lovelace's pioneering efforts from the 1840s onwards left an indelible mark on the field [George, 1976].

Subsequent to Babbage's work, Percy Ludgate, a clerk to a Dublin corn merchant, independently conceived a programmable mechanical computer, which he documented in a publication in 1909 [History, 2023]. Further advancements drew inspiration from Babbage's legacy, exemplified by the endeavors of Leonardo Torres Quevedo and Vannevar Bush [History, 2023]. Torres Quevedo proposed an analytical electromechanical machine controlled by a read-only program, introducing the concept of floating-point arithmetic. In 1920, he presented the Electromechanical Arithmometer in Paris, featuring an arithmetic unit connected to a typewriter for automatic command input and result printing. Bush, in his work "Instrumental Analysis" (1916), explored the adaptation of IBM punch card machines to realize Babbage's designs, and subsequently initiated the Rapid Arithmetical Machine project in pursuit of an electronic digital computer [History, 2023].

The evolution of electronic computing gained momentum in the 1930s with the emergence of switching circuit theory, heralding a departure from ad hoc electrical engineering practices [History, 2023]. Through a series of papers published between 1934 and 1936, luminaries such as Akira Nakashima, Claude Shannon, and Viktor Shetakov demonstrated the applicability of two-valued Boolean algebra in describing the operations of switching circuits [History, 2023]. This seminal concept laid the groundwork for electronic digital computers, providing the theoretical framework for digital system design across diverse domains of modern technology.

During his undergraduate philosophy studies, Shannon encountered the work of George Boole, realizing its applicability in arranging electromechanical relays, commonly used in telephone routing switches, to solve logic problems. This insight formed the basis of practical digital circuit design, gaining widespread recognition within the electrical engineering community during and after World War II [History, 2023].

The advent of digital machines, unbound by physical constraints inherent in analog devices, facilitated the development of logical computers capable of executing tasks describable as "purely mechanical." Alan Turing's theoretical construct, the Turing Machine, emerged as a pivotal device for studying the properties of such hardware [Computer, 2023; Computing, 2023; History, 2023].

The inception of modern computer science saw its mathematical foundations laid by Kurt Gödel with his incompleteness theorem in 1931 [Trokhimchuck, 2021]. Gödel demonstrated the inherent limits of formal systems in proving or disproving propositions, prompting further exploration into defining and describing these systems, including the introduction of concepts such as mu-recursive functions and lambda-definable functions [History, 2023].

In 1936, Alan Turing and Alonzo Church independently, and collaboratively, formalized the concept of an algorithm and its computational limits, alongside proposing a model for "purely mechanical" computation [Computer, 2023; Computing, 2023; History, 2023]. This seminal contribution culminated in the formulation of the Church-Turing thesis, positing the capabilities of mechanical calculation devices, such as electronic computers, to perform any feasible calculation provided adequate time and storage resources.

Alan Turing's profound impact on computer science extended to the publication of his seminal work on Turing machines in 1936, introducing the Universal Turing machine, which laid the groundwork for modern computers. Turing machines, abstract digital computing devices, pioneered the concept of the stored program, defining the scope of computability within established limitations on computing ability. Tasks solvable by a Turing machine are deemed Turing computable [Computer, 2023; Computing, 2023; History, 2023].

Stanley Frankel, a physicist at Los Alamos, underscored John von Neumann's recognition of the pivotal significance of Turing's 1936 paper. Von Neumann, well aware of its importance around 1943 or 1944, introduced Frankel to the paper and urged him to study it diligently. Although von Neumann is often lauded as the "father of the computer" in the modern sense, Frankel emphasized that von Neumann himself would reject such a claim, attributing the fundamental conception to Turing [History, 2023].

John V. Atanasoff's contribution to computing history is marked by the creation of the Atanasoff-Berry computer, recognized as the first electric digital computer. Constructed between 1939 and 1942 on the Iowa State campus by Atanasoff, a professor of physics and mathematics, and Clifford Berry, an engineering graduate student, this pioneering device laid the groundwork for subsequent developments in electronic computing [History, 2023].

Konrad Zuse's pioneering work further advanced the field of computing with the development of the Z3 in 1941, hailed as the world's first functional program-controlled computer. Demonstrated to be Turing-complete in principle by 1948, the Z3 showcased Zuse's innovative prowess in computer engineering. Additionally, Zuse's contributions extended to the creation of the S2 computing machine and the development of the Z4, recognized as the world's first commercial computer. Zuse's legacy is further enriched by his design of the Plankalkül, the first high-level programming language, in 1946 [History, 2023].

The completion of the Manchester Baby in 1948 marked a significant milestone in electronic computing history, as it became the world's first electronic digital computer capable of running programs stored in its memory, a feature characteristic of modern computers. Max Newman's influence, stemming from Turing's seminal work on Turing Machines and his logico-mathematical contributions, played a crucial role in the successful development of the Manchester Baby [History, 2023].

Britain's National Physical Laboratory furthered Turing's philosophies with the completion of the Pilot ACE in 1950, a programmable computer based on Turing's principles. With an operating speed of 1 MHz, the Pilot Model ACE held the distinction of being the fastest computer globally for a period. Turing's design for ACE foreshadowed elements of modern RISC architectures and featured a high-speed memory comparable in capacity to early Macintosh computers, setting it apart from its contemporaries [History, 2023].

Claude Shannon played a pivotal role in the establishment of information theory [Trokhimchuck, 2021]. The genesis of the term "computer bug" traces back to an actual moth found lodged between the relays of the Harvard Mark II, although the attribution of the term to Grace Hopper is erroneous. Accounts vary regarding the date of this incident, with some indicating September 9, 1945, and others citing September 9, 1947, when operators officially logged the occurrence [History, 2023].

The interdisciplinary field of cybernetics integrates diverse disciplines such as control systems, biology, neurology, and mechanical engineering. Engineer Harold Black's seminal contributions in 1927, outlining the use of negative feedback to control amplifiers, laid the groundwork for electronic control systems, later applied in military applications during World War II [Trokhimchuck, 2021; History, 2023]. The formalization of cybernetics as a distinct field emerged around 1940, catalyzed by the works of eminent scientists including W. Ashby, W. Walter, McCulloch, and N. Wiener [Trokhimchuck, 2021, History, 2023]. Notably, John von Neumann's addition of the concept of cellular automata and self-reproduction significantly advanced cybernetics. Often hailed as the father of cybernetics, N. Wiener published the seminal book "Cybernetics" in 1948 [Trokhimchuck, 2021].

A rudimentary schema of cybernetics as a synthetic science is depicted in Figure 1 [George, 1977].

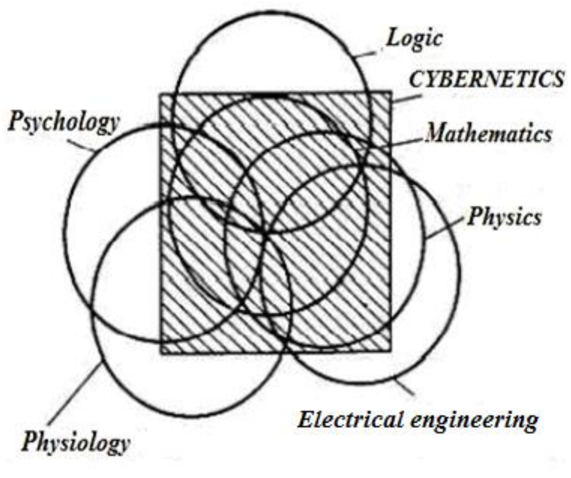

Fig. 1. A scheme that roughly illustrates the areas of intersection of the main disciplines that feed cybernetics [George, 1977]

Certainly, the synthesis of cybernetics has evolved over time, branching into various domains such as physical cybernetics, economical cybernetics, and more [Trokhimchuck, 2021].

The term "artificial intelligence" was coined by John McCarthy to encapsulate the research undertaken for a proposal at the Dartmouth Summer Research Project in 1955 [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016]. This terminology marked the birth of a new field in computer science. The research project, initiated by McCarthy, Marvin L. Minsky, Nathaniel Rochester, and Claude E. Shannon, officially commenced in 1956, comprising several significant components aimed at elucidating the nature of artificial intelligence [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016].

The foundational idea behind automatic computers, as envisioned by McCarthy and his colleagues, was rooted in the notion that if a task could be performed by a machine, then it should be achievable through the compilation of a corresponding program [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016]. However, they recognized the immense complexity of the human brain, which posed challenges in replicating its functionality through programming [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016].

Their approach involved examining how humans comprehend language and sentence structures, and then devising algorithms to emulate these processes within a machine [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016]. However, this necessitated a profound understanding of hardware-level language, typically expressed in binary code, to impart the requisite ruleset for executing specific tasks [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016].

Minsky's exploration delved into organizing artificial neural networks to emulate human brain-like qualities, yet he encountered limitations in achieving comprehensive results, indicating the need for further research in this area [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016]. Similarly, McCarthy and Shannon sought to gauge machine efficiency through mathematical theory and computations applied to complex problems, but they too faced obstacles in obtaining complete test results [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016].

The concept of self-improvement postulated the use of self-modifying code to enhance a machine's intelligence and speed of calculation, envisioning machines capable of autonomously increasing their cognitive capacities [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023, Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016]. This theoretical framework prompted exploration into machine learning algorithms aimed at refining task completion processes.

Further subdivision of research into smaller groups, including sensory perception and other facets of artificial intelligence, was proposed to facilitate comprehensive investigations [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023]. Abstractions in computer science encompass mathematical concepts and programming languages, offering avenues for studying the fundamental principles underlying computational processes [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023].

The notion of computational creativity revolved around exploring how machines could emulate human-like thinking patterns to enhance problem-solving capabilities, particularly in scenarios involving incomplete information [Nillson, 1998; Nillson, 2010; Computer, 2023; Computing, 2023; Ifrah, 2021; Koetsier, 2001; Rendall, 1982; O'Regan, 2016].

In the realm of computational sciences, logic played a pivotal role, with developments tracing back to Leibniz's pursuit of a universal calculus through formal logic [Trokhimchuck, 2021]. The advent of Boolean logic in the 19th century introduced binary systems to computer science, paving the way for more complex logical frameworks, such as Russell's inductive logic types [Trokhimchuck, 2021]. Despite these advancements, Gödel's incompleteness theorems underscored the limitations of relying solely on logic as the foundation of mathematics and computer science, prompting a shift towards an organismic approach [Trokhimchuck, 2021]. Gödel's theorems are regarded by some as integral components of the theoretical framework of computer science [Trokhimchuck, 2021].

The evolution of general theoretical approaches in computer science can be elucidated through the lens of foundational works such as S. C. Kleene's "Metamathematics" [Kleene, 1965] and S. Wolfram's seminal contributions [Wolfram, 2022]. Kleene's work primarily emphasizes logical doctrines, whereas Wolfram's approach, as highlighted in his book, emphasizes a spectrum of mathematical disciplines fundamental to computer programs, with an intuitionistic orientation [Wolfram, 2022].

Wolfram further underscores the necessity of bridging computer science with physics, positing that computational procedures are inherently linked to corresponding physical processes [Wolfram, 2022]. This assertion reflects a broader trend toward integrating mathematical and physical principles within the computational paradigm.

However, the contemporary scientific landscape suggests that this integration alone may not suffice. Many voices have advocated for a deeper convergence of mathematics and physics, giving rise to fields such as physical cybernetics. This underscores the notion that a return to the Euclid-Newtonian paradigm in computer science may not be the most fruitful path forward, necessitating a nuanced consideration of past research achievements and their implications [Trokhimchuck, 2021].

We can talk about the convergence of information theory and physics on the basis of the generalized de Broglie ratio [Trokhimchuck, 2020; Trokhimchuck, 2021; de Broglie, 1964]

$$\frac{S_a}{\hbar} = \frac{S_e}{k_B} = S_g \qquad (1)$$

about the equality of ordered and disordered information in closed system. Here S_a is an action, S_e – entropy, $\hbar$ – Planck constant, k_B – Boltzmann constant [Trokhimchuck, 2020; Trokhimchuck, 2021].Therefore, it makes sense to consider dimensionless relations not as elements of dimensionless entropy or action, but as elements of a generalized information [Trokhimchuck, 2020; Trokhimchuck, 2021].

This ratio is valid for closed systems. For open systems, we can formulate the following principle [Trokhimchuck, 2021]

$$\delta S_g > 0. \qquad (2)$$

If $S_g = S_e$ we have Shennon law of information theory and Klimontovich criterion of open systems.

In addition, relation (1) is the rationale for the introduction of information numerosity (simple, technical and generalized) as the quantifiers of relevant calculation operations, cells as we can see from (1) include relevant quanta of physical processes [Trokhimchuck, 2020; Trokhimchuck, 2021].

The polymetric analysis theory, encompassing physical and other computational processes, presents a multifaceted framework with several key components [Trokhimchuck, 2021]. These include functional numbers, which generalize quadratic forms, and generalized mathematical transformations responsible for both single-hierarchical and multi-hierarchical calculations. Information grids constructed from algebraic combinations of functional numbers and mathematical transformations form another crucial aspect. Additionally, the theory incorporates the principles of information calculations, emphasizing optimal information processing, and integrates theories of measure and dimensionality analysis into a cohesive system. Moreover, the hybrid theory of systems provides practical formalizations of knowledge within this framework [Trokhimchuck, 2021].

Fundamentally, the polymetric analysis theory operates based on two criteria: completeness and simplicity [Trokhimchuck, 2021]. Completeness entails the comprehensive layout of the system, akin to Gödelian completeness, while simplicity ensures an optimal arrangement, balancing the amount of information involved. By leveraging these criteria, polymetric analysis offers a versatile foundation for computer science, akin to Newton's fourth law in physics, which is applicable across various scientific domains [Trokhimchuck, 2021].

Furthermore, the polymetric analysis's variable hierarchy enables the creation of diverse systems akin to those proposed by Kleene and Wolfram [Kleene, 1965; Wolfram, 2022]. While Kleene and Wolfram's approaches are inductive, polymetric analysis adopts a deductive stance, serving as a potential framework for deducing intuitionistic principles [Trokhimchuck, 2021]. This deductification expands the theoretical scope, offering a novel perspective on computational processes and their underlying principles.

In whole Polymetrical Analysis and possible computer sciences must satisfy six conditions with point of conditions, which are formulated for the general theories (theories of everything) [Trokhimchuck, 2021]:

1. It must be open theory or theory with variable hierarchy.
2. This theory must have minimal number of principles.
3. It must be based on nature of mathematics (analysis, synthesis and formalization all possible knowledge).
4. We must create sign structure, which unites verbal and nonverbal knowledge (mathematical and other) in one system.
5. We must have system, which is an expert system of existing system of knowledge and may be used for the creation new systems of knowledge.
6. Principle of continuity must be true for all science.

These conditions may be considered as a more precise representation of famous Newtonian four rules of conclusions in physics [Trokhimchuck, 2021]

They must be used for the creation of any dynamic science, which can be presented as an open system [Trokhimchuck, 2021].

Conclusions

1. The problems of evolution in cybernetics and computer sciences are analyzed.
2. Short historical analysis of this problem in ancient civilizations is conducted.
3. Role antiquity and middle age scientists in the development of computer science is shown.
4. Role of B. Pascal, W. Leibniz, Ch. Babbage and A. Lovelace researches in the development of computer science is discussed.
5. Development of logical line of cybernetics and computer science and its limitations is observed.
6. Evolution of intuitionism line in computer science on the example Kleene and Wolfram systems is represented.
7. Short analysis of Cybernetics as a synthetic system is given.
8. Necessity of application of physical laws (generalizing de Broglie formula) for the creation of a universal theory of computer science is shown.
9. We show the necessity of search of a more universal concept of computer science. This concept is based on six rules. As an example of this concept, polymetric analysis is represented.

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