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Idea of Artificial Intelligence

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Abstract:
Artificial Intelligence, both as a hope of making substantial progress, and a fear of the unknown and unimaginable, has its roots in human dreams. These dreams are materialized by means of rational intellectual efforts. We see the beginnings of such a process in Lullus's fancies. Many scholars and enthusiasts participated in the development of Lullus's art, *ars combinatoria*. Amongst them, Athanasius Kircher distinguished himself. Gottfried Leibniz ended the period in which the idea of artificial intelligence was shaped, and started the new period, in which artificial intelligence could be considered part of science, by today's standards.
Keywords: artificial intelligence, ars combinatoria, Ramon Lullus, Athanasius Kircher, Gottfried Leibniz, Jan Woleński.

> Nothing is more important than to see the sources of invention which are, in my opinion more interesting than the inventions themselves.
> G. W. Leibniz [135].

To Professor Jan Woleński for his 80th birthday in a gift.

1. Introduction

The following text was written by a man and not by a machine. Some pioneers of artificial intelligence predicted that in the 21st century machines would be "thinking." February 2019 OpenAI reported on the creation of the GPT-2 algorithm, which can write competent, reasonable essays[1]. It would be disappointing for these predictions that machines do not "publish" (all) yet. The author of this text, however, not only wrote it on a computer, he also used automated support, such as checking compliance with a dictionary, thus avoiding lexical errors. The bibliography was automatically compiled according to a given pattern from data obtained from the bibliographical database. He also used the Internet to decide what to look

for, what to use and how to systematize the knowledge he acquired and to draw the conclusions that this and other knowledge had provided.
Artificial intelligence, AI, is a challenge, and as John McCarthy (1927 – 2011) believed in the 1960s, a breakthrough can occur in five to 500 years, but this challenge can never be abandoned.

The term 'artificial intelligence' (AI) was coined by John McCarthy in 1955[2] in connection with a research project. In his proposal we read [93]:

> The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves.

The Dartmouth Conference 'Summer Research Project on Artificial Intelligence' in 1956 was the first artificial intelligence conference. And there was a shift away from the physical model, the cybernetic machine thinking model, to the non-physical model, a logical, symbolic formalized system.

The term 'artificial intelligence' is one of those that can be considered a suitcase word, and therefore the initiator of this term, and the co-creator of artificial intelligence, Marvin Minsky, understands the words in which are "packed" a variety of meanings [98]. By AI, we mean both the device, the machine, and the theory of how this device works.

The context of using the term 'AI' should approximate the meaning in which it is used in a given place. The aim of AI as a field of science is to acquire knowledge that will enable the creation of AI, the assessment of the quality of operation and theoretical and practical limitations. First of all, AI is ultimately nothing more than a desire to replicate human cognitive skills in machines. The term 'artificial intelligence' could be replaced by 'cognitive technology,' which would be in substance closer to what is the subject of this discipline. AI is a research field focused on the development of systems capable of performing tasks that require human intelligence. AI as the target is a machine – it was in Alan Turing's mind, proposing a test – whose behavior is not distinguishable from human behavior [128].

The idea of what we call artificial intelligence today is – as McCorduck [94] claims, for example – rooted in the human need to do something on your own. As God created man in his likeness, so man in his likeness creates artificial intelligence. AI creators would be in this long tradition, covering everything from the time of the appearance of the Decalogue, whose first commandment prohibiting the creation of idols – you will not have other gods before me – to homunculus [14], Paracelsus (1493/4 – 1541), Golem created by Yehudah Loew ben Bezalel "Maharal" (1512/1526 – 1609) born in Poznań, Rabbi of Prague [95] and Frankenstein [27] invented by Mary Shelley (1818). However, this only points to the possible motives of those who dreamed of creating or created artificial intelligence in one form or another. These are imponderable. They are present in all human activity, and in particular in creative and scientific activity.

This consideration will be devoted to the idea of artificial intelligence and the formation of what provided a cognitive basis for scientific research or, possibly, of what is genetic to this research. So we're going to think about the intellectual rationale and the cognitive rationale of AI research. We will skip – if this does not involve the cognitive aspect in which we consider AI – the various implementations starting with the mythical products of Hefajstos, the walking lion Leonardo da Vinci [9] and others.

2. Rajmundus Lullus

The idea of artificial intelligence can already be seen at the beginning of philosophy in ancient Greece [25, pp. XV-XVII]. The inquiries of Greek philosophers, in particular the formation of the idea of formal rules of reasoning, interested one of the contemporary artists of AI, Marvin Minsky (1927 – 2008) [97, p. 106]. When the Greeks came up with logic and geometry, they were fascinated by the idea that any reasoning could be reduced to a certain kind of accounting. The greatest achievements of this ancient period include Aristotle's concept of formal logic and its syllogistics.

At the beginning of the road to artificial intelligence, however, there were dreamers. Ramon Lull (c. 1232/33 – c. 1315/16), a Catalan from Mallorca, which was then – and these were the Reconquista times, which only ended in 1492 – inhabited by large groups of Jews and Muslims. So he lived *ex oriente lux*. He is one of the most prominent writers, philosophers and scientists [10], [106].

The University of Barcelona has set up a research center on Ramona Llulla's achievements[3]. The importance of Lullus's concept for the development of artificial intelligence [28] is being considered. Lullus's legacy is also being studied at the University of Valencia. Lullus is recognized as the most influential Catalan writer and author of the first European novel *Blanquerna* [8]. The Lullus' Tree of Sciences is used as the Spanish logo of the Consejo Superior de Investigaciones Científicas (High Council for Scientific Research)[4]. The new edition of all Lullus works prepared by the Raimundus-Lullus-Institut Freiburg im Breisgau) will cover 55 volumes [122]. Recent studies show Lullus's achievements in election theory, including that he was the author – formulated a few centuries later – of the Bordy method and the Condorecta criterion. The terms 'Llull winner' and 'Llull loser' [121, chapter 3] appeared due to his works.

He is referred to as Doctor Illuminatus – a nickname he gained after meeting Duns Scotsman in 1297 – but he is not among the doctors of the Catholic Church. In 1847 he was beatified by Pope Pius IX, although in 1376 his rational mysticism was condemned by Pope Gregory XI and again by Pope Paul IV. 100 of his theses were condemned by the inquisitor Nicholas Eymerich (approx. 1316 – 1399) – yet Lullus remained in good relations with the Church. Lullus's work was synthesized by his student Thomas Le Myésier (13th century – 1336) in *Electorium* [68].

The statue of Lullus in Montserrat is characterized by the order of God – modeled on the figure of Logica Nova (1512) – by eight-step stairs: stone, flame, plant, animal, man, sky, angel, God. They symbolize the hierarchy of sciences (states of consciousness) that Lullus proclaimed. Lullus inspired many and more artificial intelligence researchers [107].

In 1265, at 33, Lullus was apprehended and became a Franciscan storyteller. He proclaimed that three religions recognizing the *Old Testament*: Judaism, Christianity and Islam should be united to stop hordes of oppression from Asia. He got involved in missionary work. He wanted to act with logic and reason. In approximately 1274 he experienced enlightenment at Mount Puig de Randa (Majorca) and got the idea of a method that he later described in the 1305 edition *Ars magna generalis ultima* [88], [91]. It was accompanied by the abbreviated version *Ars brevis* [87]. The art he designed was based on loans from Arabs – which he didn't hide – it was supposed to be a tool for converting unbelievers. Lullus spent years studying the doctrines of Jews and Arabs.

Lullus wanted to show that the Christian doctrine can be obtained mechanically with a fixed resource of ideas. One of Lullus's numerous tools for his method was the volvelle, as he called a device he had constructed.

If the logical machine is understood as the logic data processing system, Aristotle, creating the concept of formal logic, gave rise to a symbolic logical machine, and Lullus' volvelle can be seen as a physical logical machine, and this is usually referred to as a ‘thinking machine.’

The name “volvelle” comes from the Latin verb “volvere”, which means as much as “rotate”. Inspiration can be seen in the Arabic astrological device *zairja* [85]. Lullus most likely experience of *zairja* would have been during the missionary expeditions [86], [129]. *Zairja* was used by Arab medieval astrologists.

The term ‘*zairjah*’ derives from the Persian words ‘*za’icha*’ (horoscope, astronomical table) and ‘*da’ira*’ (circle) [85, p. 216].

A volvelle was made of paper or parchment. There was a volvelle with which to resolve religious disputes. A combination of nine letters was produced, representing nine attributes of God (which all monotheists recognize) written on a moving wheel. Depending on the subject, there were two or more such wheels. Another volvelle, called the “Night Sphere” by Lullus, was used to calculate the time over the night by the position of the stars. It was possible to determine the hours in which, according to the movement of the heavenly bodies, medication is most effective. The moving parts of the volvelle were placed on the blue bodies on the timer or on God's attributes and arguments for His existence, but it depended on the subject. Lullus wanted to – as if we would say today – mechanize the reasoning process. He claimed that his art lead to more certain conclusions than logic itself, and that it is therefore possible to learn more in a month than through logic in a year.

Werner Künzel was so fascinated by Lullus' ‘machine’ that he writes [67]:

> Since 1987, I have programmed this first beautiful algorithm of the history of philosophy into the computer languages COBOL, Assembler and C.

The Lullus method assumed that the number of fundamental truths is limited, and all the truths of a given field are derived from them in general by combinations of relevant terms. The machine was supposed to put together combinations and to indicate which ones are real.

A volvelle [112] is also a functionally related astrolabe. An astrolabe is a device that has been used to observe and calculate the positions of heavenly bodies. It can be seen as a kind of analog computer for astronomical calculations.

Volvelle, or rather those who used them, were suspected of black magic. Perhaps this approach was based on the mystical inspiration of the creator Lullus, and the fact that the device was used to predict the future. Numbers and measurements were attributed to spiritual and supra-natural potentials.

In Lullus' time, especially in Spain, the Jewish community developed a Kabbalah, and its origins take place in Cataloni in the 12th century [45], [46]. According to the Jewish tradition, Hebrew is the language that God used to create the world. The *Sefer Yetsirah* (*Book of Creation*), one of the earliest Jewish mystical texts (it was written between the 2nd and 7th century), describes the process of creation as being accomplished with 22 letters of the Hebrew language and cardinal numbers. The *Sefer Yetsirah* explained how one could imagine and possibly repeat the creation by manipulating the letters of the Hebrew alphabet. Thus, was created the Golem (*Psalm* 139:16). It was believed that by giving the name to the Golem one could revive him and control his conduct, and by wiping out that name one could destroy him.

Kabbalah interprets the Torah using anagrams and other linguistic combinations. Lullus can be seen as someone who inspires these techniques in the search for a new way of evangelization. He wrote about Kabbalah[5] that its object is creation, or language. For this reason, it is clear that its wisdom governs the other teachings. They have their roots in it. For this reason, these teachings are subordinated to this wisdom, and the principles of science and their rules are subordinated to the rules of Kabbalah. The scientific argument alone without the Kabbalah is insufficient.

Lullus provided the basis of the medieval Christian Kabbalah in its various varieties. In each case, the objective was one: by applying the rules of Kabbalah to prove that Jesus was the Messiah. Because God created the world using the Hebrew language, the contemplation of this language was the contemplation of both God and His creation. Lullus used the Latin alphabet, but the idea of the combination was the same.

Computer scientists have identified Lullus as someone who provided the (pre)origins of computer science [16], [10, p. 290], [65, p. 56]. Lullus is the one from whom you can start the story of ideas of thinking machines, which is the story of artificial intelligence.

Lullus's idea was revolutionary for two reasons, namely that the volvelle could be seen as an 'artificial memory,' which freed the user from remembering a large amount of detailed information, and its resources could be exchanged and then it could produce new knowledge. The content of this knowledge was dependent on the content of 'memory.' So in a sense, it was the idea of a universal machine.

Lullus is an important figure in the history of AI, primarily for the reason that he has interacted with many prominent researchers who have relaunched his idea in successive eras [10, pp. xii-xiv]. The idea of *ars raymundi* has revived the European public's inquiries for several centuries.

Let's list the most prominent Lullists in chronological order according to the date of their birth who contributed to the development of AI. So, we'll skip characters like Martin Luther (upon whom Lullus also acted on).

3. Lullists

Lullus gave us the beginning of a concept that has survived at least until the times of Gottfried Leibniz [81], [119]. Among many ideas, let's point out those whose ideas had the most impact on building a thinking machine. Not everything is known. In the 16th century, the biggest Lullist was Franciscan Bernard de Lavinheta. However, we do not know much about him. It is known that his release of Lullus' work was most common in Europe at the time [89, vol. I, p. 80].

3.1. Giovanni de la Fontana

Giovanni de la Fontana (c. 1390 – 1455/56) [38] was an outstanding – as we would say today – designer. He learned the art of engineering from Greek and Arabic texts. In the encrypted *Bellicorum instrumentorum liber, cum figuris et fictithousand litoris conscriptus* [50] he illustrated and described various instruments of war. In the *Secretum de thesauro experi mentorum ymaginationis hominum* [32] he made available to readers about 1430 – also written in an encrypted manner – in which he studied different types of memory and explained the function of artificial memory. He proposed some devices for remembering and 'machinery' with fixed structure and mobile parts and variables, allowing a combination of characters – including a direct link to the Lullus design.

3.2. Nicholas of Cusa

Nicholas of Cusa (1401 – 1464) in the *De coniecturis* [99] develops its method *ars generalis coniecturandi*. He describes how to make assumptions, illustrating this with circular diagrams and symbols very similar to Lullus'. Venice, in which he lived, entered into contact with Byzantine and Arab countries. The question that Lullus had asked two centuries earlier became natural about the universal language for building an agreement between East and West.

3.3. Giordano Bruno

Giordano Bruno (1548 – 1600) uses Lullus' idea to create artificial memory, and he uses this technique to make rhetorical discourse. Kircher comments later in 1669 [59, p. 4] that Giordano Bruno also developed Lullus' volvelle technique so that an unlimited number of sentences can be generated [12]. In his system, alphabetic combinations do not lead to images, but rather combinations of images lead to syllables. This system not only facilitates memory, but also enables the generation of almost unlimited words [26].

3.4. Thomas Hobbes

Thomas Hobbes (1588 – 1679) is not referred to as Lullist in the sense of referring to Lullus. The Hobbs' doctrine is important primarily because of the concept of thinking as a calculation and influence on Leibniz. I also know nothing about the contacts between the outstanding Lullist Kircher and Hobbs. Hobbes was 14 years older than Kircher. Hobbes published the *Leviathan* in 1651 that we are interested in and Kircher published the *Ars Magna Sciendi* in 1669, 18 years later [59].

Hobbes uses the term '*ratiocinari*' to mean both reasoning and accounting, as one thing. It was understood as calculation consisting of addition and subtraction, simply an arithmetic operation. He cited various reasons for this approach, referring to the meaning of the relevant words in Greek and Latin [42, chapter IV]. He added that 'syllogism' actually means adding, summing. The word count corresponds to the grammar, the syntactics of natural language, understood as an operation on words.

Hobbes is the first who directly formulated the concept of syntactic operation as calculation. Syntactic procedures are arithmetic. Hobbes recognizes the functional nature of syntactics as a kind of technical procedure. Words are used as numbers, i.e. as agreed artificial marks. His saying is famous [42, chapter IV]: "Words are wise men's counters"[6]. The symbolic character of words is, according to Hobbs, the essence of their nature from the very beginning of creation. Adam invented the words *ex arbitrtrio*. Although, as Hobbes writes [42, chapter IV]:

> The first author of Speech was GOD himself, that instructed Adam how to name such creatures as he presented to his sight.

Hobbes had a negative score on the Kabbalah. At the end of Chapter XL of the *Leviathan*, he wrote that the Kabbalah took over the Greek demon and through the Kabbalah the Jewish religion became more corrupted (their Religion became fly corrupted).

On reasoning as calculation Hobbes writes [42, chapter V]:

> When a man *reasons*, he does nothing else but conceive a sum total from addition of parcels – These operations are not incident to Numbers onely, but to all manner of things that can be added together, and taken one out of another. […] The Logicians teach the same in Consequences Of Words; adding together Two Names, to make an Affirmation; and Two Affirmations, to make a syllogisme; and Many syllogismes to make a Demonstration; and from the Summe, or Conclusion of a syllogisme, they substract one Proposition, to finde the other.

He also writes further:

> Out of all which we may define, (that is to say determine,) what that is, which is meant by this word Reason, when wee reckon it amongst the Faculties of the mind. For Reason, in this sense, is nothing but Reckoning (that is, Adding and Subtracting) of the Consequences of generall names agreed upon, for the Marking and Signifying of our thoughts; I say Marking them, when we reckon by our selves; and Signifying, when we demonstrate, or approve our reckonings to other men.

The first task of language is a mental discourse, and therefore it is a cognitive function. The second task is to transfer knowledge to others. The third is to communicate our will to others, and the fourth is an entertainment and artistic function [42, chapter IV].

Hobbs' views on language and reasoning were significantly influenced by mechanics, the new subdiscipline of physics that Galileo Galilee provided the beginning of [132]. Galileo says: "*universum horologium est*."

For Hobbs the computational use of natural words is the first need to obtain a reasonable, i.e. a real insight, and secondly, if the calculation is done right, get complete reliability and complete confidence.

3.5. Athanasius Kircher

Athanasius Kircher (1602 – 1680) is the famous Jesuit scholar, the new Aristotle, the last who knew everything [31], the master of one hundred works [109], [110], the last man of the Renaissance [39] – he has a multitude of contributions to mnemotechnology, to the development of mechanization of calculating of "thoughts," to the design of slots and to the search for a universal language that would ultimately free humanity from the curse of the tower of Babel [82].

Kircher's scientific achievements impress with both diversity and size[7]. As a curiosity, he was the first scientist to be able to ensure his preservation from the sale of books [52, p. 96].

Findlen writes [31, p. 329]:

> During his own lifetime his books could be found in libraries throughout the world. He had a global reputation that was virtually unsurpassed by any early modern author.

In the *Encyclopedia Britannica* we read:

> […] settled in 1634 in Rome. There he remained for most of his life, functioning as a kind of one-man intellectual clearinghouse for cultural and scientific information gleaned not only from European sources but also from the far-flung network of Jesuit missionaries.

The interest in the person and achievements of Anathasis Kircher dates back to the 1980s. For three centuries he was forgotten. Knittel (1644 – 1702) wrote the following book about Kircher in 1682: *Via Regia ad omnes scientias et artes. Hoc est: Ars universalis, scientiarum omnium artiumque arcana facili us penetrandi* [4]. It was the last thesis that openly defended Kircher's approach to knowledge, which was the subject of sharp criticism at the time. Knittel as his authority points to Pitagoras (c. 570 – c. 495 B.C.), Aristotle (384 – 322 B.C.), Raimundus Lullus, Sebastián Izquierdo (1601 – 1681), and Kircher. The *Via Regia* was very popular and had numerous editions [44]. At this time, Newton, who, like Leibniz, was fascinated by many of the questions that triggered Kircher's concept, came to completely different conclusions.

Donald Knuth in the *Art of Computer Programming* [65, pp. 60-61] points out three 17th century authors, as those who made discoveries used by computer science. They are: Tacquet, van Schooten, and Izquierdo mentioned above. Sebastián Izquierdo is the author of the work *Pharus scientiarum ubi quidquid ad cognition humanam humanitús acquisibilem pertinet, ubertim iuxtà, atque succinctè pertractaur* [49].

Today's science historians see Kircher's scientific achievements as helpful in understanding the transition from ancient to modern ways of thinking about the world [61]. Major research projects are being carried out [4], [37], [51], [123].

The Museum of Jurassic Technology[8] has a permanent exhibition dedicated to Kircher and his legacy: 'Athanasius Kircher: The World Is Bound With Secret Knots'. From 07.03 to 10.04.2008 in Collegio Romano, where Kircherianum was there, the artist Cybéle Varela organized an exhibition 'Ad Sider per Athanasius Kircher' ('To the Stars by Athanasius Kircher').

His correspondence must be taken into account when trying to determine the inspiration and influence of Kircher's work. Among the 686 people who wrote to him are, among others, Leibniz, Torricelli, and Gasendi [4]. The archive in Gdańsk contains his letters to Hevelius, and the archive of the Mazovian letter to Kochański. There are 2741 letters [51], [123]. In the context of these considerations, any correspondence with Hobbes would be interesting. I have not found any data about that correspondence. Descartes is not among the respondents (1596 – 1650).

Kircher takes Lullus' ideas first of all in the *Ars Magna* [59]. The work consists of XII books. There are books whose titles directly point to the issues of interest: III. Methodus Lulliana; IV. Ars Combinatoria.

Kircher not only discusses the Lullus concept, but also presents a new and universal Lullus method of combination concept. It seems to have the belief that Lullus' method of combination is secret and mystical, that is this is esoteric.

Kircher used the same wheels as Lullus, but differed in the choice of symbols to be combined. This notation makes a difference. He tried to produce possible combinations of all finite alphabets (not only graphic, but also mathematical). Kircher was known for his coding and decoding skills. He tried to read the hieroglyphs, he also learnt Coptic and he is the author of the first grammar of this language *Prodromus coputs sive aegyptiacus* [54], and in *Lingua aegyptica restituta* [56] he showed that Coptic is the last phase of development of the ancient Egyptian language. A more mathematical approach distinguishes his project from the Lullus project. The universal language, *lingua universalis*, not only allows you to understand everything, but also is a tool for close investigation.

The idea of binding digits to words is realized in gematry, which is a component of the Kabbalah [108]. The name derives from 'geometry.' Gematry originates in the Assyrian-Babylonian alphanumeric coding system. Others had similar ideas, including Greeks and Arabs.

Kircher not only addressed the theoretical issues of encryption and decryption, but also designed a coding and decoding machine. These and other machines, collected by Kircher, were in Kircherianum[9] [30], [31]. This is one of the first public museums in which, in addition to the artifacts obtained, he presented the many fruits of his invention, including models of robots, equipping them with speaking tubes so that the vending machine greeted visitors [40], [82], [83], [134]. In the 14th and 15th centuries, there were no shortage of designers of various kinds of machines and automata; as shown by someone like Leonardo da Vinci (1452 – 1519).

In 1649 Kircher invented the first of the brands, or cistae – these were wooden boxes that had written numbers, words, and sounds (*Arca musurgica*) [63], in general everything that can be automatically processed by a machine that combines things according to the logic defined and programmed by the inventor [64, p. 60], [96]. These bodies, as they were also called for because of their similarity to musical bodies, formed a complementary system of dissemination of encryption systems (polygraphic and steganographic) [31, p. 287].

In the museum of science history Museo Galileo[10] there is *Organum Mathematicum* [62], which Kircher designed for Prince Karl Joseph from Austria. It contained all the mathematical knowledge necessary for the prince. Simple arithmetic, geometric and astronomical calculations were made by manipulating wooden rods. It was possible to write messages with a digital code, design reinforcements, calculate the Easter date, and compose music. Although Kircher declared that obtaining mathematical knowledge would not be burdensome, many operations required mathematical fitness and memorization of long Latin poems [114][11]. *Abacus Harmonicus* (*Abacum Arithmetico-Harmonicum*), the tabularist method of creating music was described in the *Musurgia Universalis* [57], see also: [41], [119]. *Arca Musarithmica* used the aleatorical method to compose music, which is described as capable of producing millions of church anthems by a combination of selected musical phrases. Kircher's "musical" ideas are highlighted by Donald Knuth in his fourth volume the *Art of Computer Programming. Generating All Rrees. History of Combinatorial Generation* [65, pp. 52, 53, 59, 74].

Kircher in the *Polygraphia nova et universalis, ex combin atoria arte detecta* (1663) [58] designed not only polygraphy, an international language available to all, but also steganography, a secret language for encrypting messages. In creating polygraphy, Kircher used – as he himself writes – Lullus' *ars combinatoria*.

In the introduction to the *Polygraphia nova et universalis, ex combin atoria arte detecta* addressed to Emperor Ferdinand III Kircher wrote about polygraphy that all languages are reduced to one (*linguarum omnium ad unam reductio*). Anyone who uses polygraphy, even if he did not know anything other than his own speech, would be able to communicate with anyone else, regardless of their nationality. This polygraphy would be basically pasiography, i.e. a written language design or an international alphabet that would not have to be spoken.

These actions are motivated by the desire to restore humanity to the language before the mixing of languages, which is a consequence of the erection of the tower of Babel. These are ideas for realizing the human longing for the perfect language spoken by Adam and Eve in Paradise [26, pp. 196-200]. The longing to understand everyone, no matter what language he or she speaks, is also cited in the New Testament, when on the day of sending the Holy Spirit, everyone, no matter what country he or she was from or what language he or she was speaking, understood what the apostles preached, although they spoke in their own language.

Kircher's distinction between two dictionaries could be associated with modern methods of automatic translation: everything is translated into one distinguished language, and from this language only into each other. Dictionary A was used for encoding and dictionary B was used for decoding the message. For example,[12] [58, pp. 9-14]:

XXVII.36N XXX.21N II.5N XXIII.8D XXVIII.10 XXX.20

was decoded to Latin as:

Petrus noster amicus, venit ad nos.

According to Knittel, Kircher created *clavis universalis*, a universal key, opening access to the secrets of the universe [31, p. 5].

3.6. Universal Language

The 17th century is fertile in the concepts of artificial languages. A universal language was sought, understood as a language in which all courts and concepts could be expressed and, moreover, capable of accounting processing. It would be the language of invention in the sense of Hobbes.

John Wilkins (1614 – 1672), one of the geniuses of that time, had the task of creating a universal language. He knew Kircher's work [136, p. 452]. In the *Essay towards a Real Character and a Philosophical Language* (1668) [136], where he presented his concept of language, there is no mention of Hobbs – and he was, like Wilkins, an English philosopher. There is no mention of Leibniz, but his *Dissertatio de Arte Combinatoria* (1666) [69] was published two years earlier than Wilkins the *Essay towards a Real Character and a Philosophical Language* (1668). It turns out that Wilkins' precursor was Dalgarno, the author of *Ars Signorum* [20], cited by Leibniz.

Wilkins was mindful of the universal language, which would primarily facilitate an international communication of scholars. It was supposed to replace Latin, though it had a thousand-year history in the teaching of the Christian world. Latin, he declared, was difficult to learn. Unlike other projects of that time, the new universal language was supposed to be only a secondary language. *Lingua franca* could also be used for diplomacy, travel, trade and other situations [137].

The *lingua franca* scheme based on mathematical coding was published in 1630 by an English mathematician John Pell [92, p. 55]. The idea of simplifying Latin was also close to Giuseppe Peano (1858 – 1932) [53], a famous Italian mathematician who proposed Latin without flexion in the *Latino sine flexione, Interlingua de Academia pro Interlingua* (1903) [100]. In the context of our deliberations, it is worth highlighting Peano's reference to Leibniz by placing samples of his writings as a motto to individual paragraphs of his text. In 1926 'Instituto pro Interlingua' was established to continue the work. Until 1939, the Institute published the journal 'Schola et Vita' [7, p. 154].

4. Gottfried Wilhelm von Leibniz

Gottfried Wilhelm von Leibniz (1646 – 1716) was a scholar to whom many who referred, in particular Frege, who, writing *Begriffsschrift* (1879) [33], pursued the idea of universal language, *lingua characteristica* and formal calculation, *calculus ratiocinator*.

In the Leibniz concept, all the rational elements of Lullist inquiries have been accumulated. He took over Hobbes' heritage of the arithmetic philosophy of language. He developed his ideas of artificial language and symbolic systems [28].

In the letter to Hobbes of July 1670 [78, pp. 105-106], he wrote that he had read almost all of his works and that he had used them as with few others. This letter was not delivered to Hobbes and later remained only as a sketch [115].

Leibniz as a student became familiar with the late-scholastic thought of Jesuit Francisco Suárez (1548 – 1617), who enjoyed respect at Lutheran universities. The relationship between Leibniz and another Jesuit is interesting, namely Athanasius Kircher [36]. In the 'Synopsis Dissertationis De Arte Combinatoria', the *Dissertatio de arte combinatoria* (1666) [69] refers to Lullus and his art. He learned about it mainly through Kircher's work. 16 May 1670 he wrote a letter to Kircher [36, pp. 229-231] and received a reply on 23 June 28 [36, pp. 232-233]. Leibniz in the letter refers to his *Dissertatio de arte* *combinatoria* [69] and expresses admiration for Kircher's newly published work *Ars Magna* (1669) [59]. The value of *ars combinatoria* sees in its function as a *logica inventoria* and in the development of *scriptura universalis*. He writes about its use in the attempts to establish a new order and the basis of the system of law at that time. However, it emphasizes its fundamental function as a general basis for scientific knowledge. It was close to Kircher, who himself pointed to the important role of *ars combinatoria* for the solidifying of such different sciences as mathematics, medicine, law study, and theology. Leibniz was also interested in Kircher's writings about Egypt and China.

Leibniz's concept of thinking as a calculation takes over from Hobbs. It remains for him to determine what the units are (parcel) that Hobbes refers to as arguments of accounting operations. The concept of Lullus' art, developed in the *Dissertatio de arte combinatorial* [69], written at the age of 19, integrated with its metaphysics and philosophy of science.

The *Dissertatio de arte combinatoria* is an extended version of the PhD dissertation that was prepared before Leibniz undertook his mathematical research. The release in 1690 resumed without Leibniz's consent. Leibniz has repeatedly expressed his regret that there is a version in circulation that he considers immature.

Examples of problems to which the *ars combinatoria* are applied are issues from the law, music, the Aristotelian concept of four types of matter (presented in the form of diagram, and thus in a manner typical of Lullus), all of which is complex, and above all – from the point of view of the subject that we are interested in, but also of what has been the test of time – are applications to reasoning.

Leibniz is considered the most prominent logician from Aristotle until George Boole who published the *Mathematical Analysis of Logic: Being an Essay Towards a Calculus of Deduction Reasoning* (1847) [11], and Augustus de Morgan who pblished the *Formal Logic: or, The Calculus of Inference, Necessary and Probable* (1847) [23].

Leibniz wanted the universal language to make it possible to make the rules of calculations logical. He wrote [77, p. 664]:

> At the same time this could be a kind of universal language or writing, though infinitely different from all such languages which have been proposed, for the characters and the words themselves give directions to reason, and the errors – except those of fact – would be only mistakes in calculation. It would be very difficult to form or invent this language or characteristic but very easy to learn it without any dictionaries.

In the letter to the mathematician G. F. A. L'Hospital, we read [22, chapter 1] that the part of the "algebra" secret is included in the characteristics, i.e. in the art of proper use of symbolic expressions. A concern for the proper use of the symbol would be *filium Ariadne*, which would lead the researchers in creating this characteristic.

In the *Dissertatio de arte combinatoria* he criticized Lullus' 'alphabet' as limited and proposed an alternative, extended, and instead of letters he considered it appropriate to use numbers. For example, he proposed that '2' should represent space, 'between' should be represented by '3' and the whole by '10'. This encoding encodes 'episode' as 2.3.10. By digital encoding, all problems will be reduced to mathematical problems and solved by accounting operations. This idea anticipates the modern AI [28]. Digital coding has already been used by other Lullists of Leibniz's predecessors.

When we proclaim the researcher's contribution to scientific development, we take into account what Leibniz knew when he wrote [77, p. 664]:

> […] Besides taking care to direct my study toward edification, I have tried to uncover and unite the truth buried and scattered under the opinions of all the different philosophical sects, and I believe I have added something of my own which takes a few steps forward.

Leibniz's contribution to the development of the AI concept is noted, first of all, in two new novelties of his inquiries, or rather – which would be more cautious given that one can find predecessors – in indicating relevance and subsequent impact, first of all, in a situation where our knowledge is not certain and we have to settle for probability and, second, not only cognitive, but also ontological location of the binary system.

AI is supposed to behave like a man who doesn't make a mistake. AI must therefore also deal with situations that human beings deal with, in particular when taking decisions and acting in conditions of incomplete or uncertain information. This aspect is noted by Leibniz (in relation to the universal language, which in the context of his speech we can understand as a "thinking machine"). Leibniz [77, p. 664] wrote:

> When we lack sufficient data to arrive at certainty in our truths, it would also serve to estimate degrees of probability and to see what is needed to provide this certainty. Such an estimate would be most important for the problems of life and for practical considerations, where our errors in estimating probabilities often amount to more than half […]

Leibniz in many texts and letters written between 1679 and 1697, i.e. for eighteen years, developed a notation and solved an algorithmic (mechanical) execution of arithmetic operations. He also drew up a draft of rules for the binary machine, using balls and holes, sticks and grooves to move them[13] [70], [72], [116], [126], [127].

Leibniz considered the idea of three-valued logic in the *Specimina Iuriss III* [113, 1931, p. 20].

The binary system as the basis of machine counting is also indicated by the prominent English inventor Thomas Fowler (1777 – 1843), who also designed a wooden 'computer,' operating according to the rules of ternary system[14] [131].

In January 1697 Leibniz, with his birthday wishes, sent the letter to his protector Prince Rudolf Augusta of Brunswick (Herzog von Braunschweig-Wolfenbüttel Rudolph August), discussing the binary system and the idea of creation with 0 as nothingness and 1 as God [120].

For Leibniz [71], nothingness and darkness correspond to zero, while the radiant spirit of God corresponds to one. For he thought that all combinations arose from unity and nothingness, which is similar to when it was said that God had done everything out of nothing and that there were only two principles: God and nothingness. He designed a medal, whose main theme was *imago creationis* and *ex nihil ducendis Sufficit Unum*. One corresponds to the Sun, which radiates to the shapeless earth, zero. He referred to Pythagoras and Plato. From the spirit it was Kabbalistic, it was embedded in gematry.

The idea of binary code is not new [84]. Leibniz himself pointed to the predecessor in the person of the thirteenth-century Arabic mathematician Abdallah Beidhawy. In approximately 1600 the binary notation was used by the English astronomer Thomas Harriot. Shirley writes about his achievements [118]:

> Though it is frequently stated that binary numeration was first formally proposed by Leibniz as an illustration of his dualistic philosophy, the mathematical papers of Thomas Hariot (1560 – 1621) show clearly that Harriot not only experimented

with number systems, but also understood clearly the theory and practice of binary numeration nearly a century before Leibniz's time.

A similar opinion is given by [47]:

> He is probably the first inventor of the binary system, as several manuscripts in his legacy show. In the binary system, he uses the numerals 0 and 1 and shows examples of how to move from the decimal system to the binary system and vice versa (conversion or reduction). Using further examples, he demonstrates the basic arithmetic operations.

Ineichen had the first publication on the binary system, in 1670. Two-volume book *Mathesis biceps vetus et nova* (1670) [48] by Ioannis Caramuelis. Either way, Leibniz developed a binary system, which is how to perform both arithmetic operations – as he described it – and logical operations – as Boole did. With his conviction that everything is created from 0 and 1, he anticipated what modern computer science is doing, that all information can be written in binaries. The ontological thesis about the world as created by 1 using 0 opened up new perspectives for linking the information system to metaphysics. While praising his binary arithmetic Leibniz claimed [79]:

> *tamen ubi Arithmeticam meam Binariam excogitavi, antequam Fohianorum characterum in mentem venirent, pulcherrimam in ea latere judicavi imaginem creationis, seu originis rerum ex nihilo per potentiam summae Unitatis, seu Dei.*

> But when I invented my binary arithmetic, before I became familiar with the symbols of Foha, I recognized in them the most beautiful image of creation, that is, the origin of things from nothing thanks to the highest power of Unity, that is, God.

This idea of Leibniz was so fascinating that it was passed on to Father Grimaldi, a mathematician at the of court of the Emperor of China, in the hope that it would lead to the conversion of the Emperor and, with him, to the Christianization of the whole of China [71].

After 1703, i.e. after the publication of *Explication de l'arithmétique binaire, qui se sert des seuls caractères 0 et 1, avec des remarques sur son utilité, et sur ce quélle donne le sens des anciennes figures Chinoises de Fohy* [72], there is an increase of interest in systems that are not decimal. The use of binary in computers was ultimately determined only by the *Burk-Goldstine – Von Neuman Report* of 1947, in which we read [13, p. 105]:

> An additional point that deserves emphasis is this: An important part of the machine is not arithmetical, but logical in nature. Now logics, being a yes-no system, is fundamentally binary. Therefore, a binary arrangement of the arithmetical organs contributes very significantly towards a more homogeneous machine, which can be better integrated and is more efficient.

Giuseppe Peano (1858 – 1932) designed an abstract shorthand machine based on the binary encoding of all Italian syllables between 1887 and 1901. Together with phonemes using 16 bits (so it had 65,536 combinations), 25 letters of the (Italian) alphabet and 10 digits were encoded. Peano's code was not noticed and was forgotten. The American Standard Code for Information Interchange (ASCII) and its various extensions are used in today's coding computers. Since 2007 coding on the Internet is done using UTF-8, which is backwards compatible with ASCII.

The idea that everything is created from 0 and 1 is the reason why the creator of the algorithmic theory of information Chaitin – as he writes not quite seriously – proposes to name the basic unit of information not 'bit' but 'leibniz' [15], [125]:

> […] all of information theory derives from Leibniz, for he was the first to emphasize the creative combinatorial potential of the 0 and 1 bit, and how everything can be built up from this one elemental choice, from these two elemental possibilities. So, perhaps not entirely seriously, I should propose changing the name of the unit of information from the bit to the leibniz!

The 'leibniz' unit could be the unit (parcel) that Hobbes wrote about. Leibniz was convinced that the world was designed according to the principles of mathematics. This thought is abbreviated [78, p. 191]:

> *Cum Deus calculat et cogitationem exercet, fit mundus*
>
> When God thinks about things and accounts, the world appears.

Mathematics is the tool of the Constructor of the world, and numbers are the material from which the world is made. This idea is based on the Old Testament *Book of Wisdom* (canonical for Catholics and Orthodox Christians, Ethiopian and Syrian Christians – it was created in the Hellenistic world), in which we read (11:20):

> But you have arranged all things by measure and number and weight!

The idea of world mathematics lies at the heart of modern natural science, the origins of which are usually related to the speech of Galileo, who claimed that the book of nature is written in the language of mathematics.

If thinking is a calculation, and the world is made of numbers, then we will come to any truth that we can come to, by the way of accounting. Thus [75, vol. 7, p. 200][15]:

> *Quo facto, quando orientur controversiae, non magis disputatione opus erit inter duos philosophos, quam inter duos Computistas. Sufficiet enim calamos in manus sumere sedereque ad abacos, et sibi mutuo (accito si placet amico) dicere: c a l c u l e m u s.*
>
> If the dispute had arisen, the dispute between the two philosophers would not have required much effort than between the two accountants. For it would be sufficient for them to take pencils into their hands, to sit by their slats, and one to the other (with a friend as a witness if they wished) to say: Let's count.

Calculating is an activity in which a machine can replace a human. In 1685, in discussing the value for astronomers of a machine invented in 1673 more efficient than pascalina and performing all basic arithmetic activities, he wrote [22, chapter I: Leibniz's Dream], [76, p. 181] that:

> For it is unworthy of excellent men to lose hours like slaves in the labor of calculation which could safely be relegated to anyone else if the machine were used.

This pragmatic argument with the above metaphysical arguments can inspire computer science and the development of its tools towards artificial intelligence. All truths have a numerical representation, and thinking is represented by numerical operations, and all this can be done by the machine.

Frege critically continues the Leibnizian program, as he writes in the introduction to the published *Begriffsschrift* [33], [34, p. XI]:

> Auch Leibniz hat die Vortheile einer angemessenem Bezeichnungsweise erkannt, vielleicht überschätzt. Sein Gedanke einer allgemeinen Charakteristik, eines calculus philosophicus oder ratiocinator war zu riesenhaft, als dass Versuch ihn zu verwirklichen über die blossen Vorbereitungen hätte hinausgelangen können. Die Begeisterung, welche seinen Urheber bei der Erwägung ergrift, welch unermessliche Vermehrung der geistigen Kraft der Menschheit aus einer die Sachen selbst treffenden Bezeichnungsweise entspringen würde, liess ihn die Schwierigkeiten zu gering schätzen, die einem solchen Unternehmen entgegenstehen.
>
> Wenn aber auch dies hohe Ziel mit Einem Anlaufe nicht erreicht werden kann, so braucht man doch an einer langsamen, schrittweisen Annäherung nicht zu verzweifeln. Wenn eine Aufgabe in ihrer vollen Allgemeinheit unlösbar scheint, so beschränke man sie verläufig; dann wird vielleicht durch allmähliche Erweiterung ihre Bewältignung gelingen. Man kann in den arithmetischen, geometrischen, chemischen Zeichen Verwirklichungen des Leibnizischen Gedankens für einzelnen Gebiete sehen. Die hier vorgeschlagene Begriffsschrift fügt diesen ein neues hinzu und zwar das in der Mitte gelegene, welches allen anderen benachbart ist. Von hier aus lässt sich daher mit der grösten Aussicht auf Erfolg eine Ausfüllung der Lücken der bestehenden Formelsprache, eine Verbindung ihrer einzigen und eine Ausdehnung auf Gebiete ins Werk setzen, die bisher einer solchen ermangelten.

Leibniz also recognized the advantages of a suitable method of labeling, perhaps overestimated by him. His idea of universal characterization, *calculus philosophicus* or *ratiocinator*, was too titanic, so that the attempt to make it a reality could only be achieved by preparation. The enthusiasm which took over his initiator in considering how it unimaginably multiplied the spiritual power of mankind, which would in fact flow from the proper way of marking, made it estimate the difficulties too weakly that such an undertaking would encounter. When they did not reach the target at one time, they should not be doubted as they approached slowly in steps.

When a task in its entirety seems insoluble, it is temporarily restricted; then, perhaps, through a gradual enlargement, it will be resolved. Arithmetic, geometric, and chemical signs can be seen as the realization of Leibniz's idea for these particular fields. Here, the proposed conceptual letter supplements them with new ones and, although it is in the middle, what is close to everyone else. Hence, it seems to have the biggest view of the success of filling this gap in the existing formula language, by developing a combination of the individual and extending to the areas that lacked it.

There's no idea of using a language designed by Frege in learning. *Lingua universalis* brings us closer to programming languages. John McCarthy, one of the initiators of modern

AI research, created the LISP[16] programming language. Today LISP is a family of such languages.

Leibniz was not only interested in the Kabbalah, but the concepts of Kabbalah, especially those of Lurian, had an impact on his views and actions mainly thanks to Franciscus Mercurius van Helmont (1614 – c. 1698/1699), who was a frequent visitor in Hanover and with whom Leibniz spent much time. He had already learnt the Kabbalah as a student. In the 17th century, in the times of the Enlightenment, Platonism, Kabbalism, and Gnosticism were popular, especially in Protestant Germany. In the case of ecumenical Christians like van Helmont, the Kabbalah had a significant impact on their optimistic non-dogmatic philosophy [18]. Leibniz, at the end of his life, accepted the radical Kabbalistic idea of *tikkun*, and the belief was that all things would ultimately be perfected by recurring transformations.

He believed in progress. He was involved in efforts to improve human health through ecumenical action, the promotion of tolerance, and the development of education and science. Leibniz's attitude to knowledge was expressed by the *theoria cum praxis* formula, which is the motto of the Kurfürstlich Brandenburgischen Sozietät der Wissenschaften (now: Berlin-Brandenburgischen Akademie der Wissenschaften). Leibniz-Sozietät der Wissenschaften[17] uses the motto: *theoria cum praxis et bonum commune*. He claimed that if we consider disciplines in and for ourselves, they are all theoretical; if we consider them from the point of view of application, they are all practical.

Socially useful ideas were also meant to improve life. He was very interested in various kinds of inventions, for example. He corresponded with Papin, who was building a steam machine – which Frege comments on later [35]. Leibniz [76] is known as the designer of the calculating machine. He had the idea since 1672. The first structures, as the documents show, took place between 1674 and 1685. The so-called older machine was made in the years 1686 – 1694. The younger machine, which behaved, was built in the years 1690 – 1720. In Göttingen in 1879, the original of the instrument was found. One of the copies which he had constructed Leibniz had given to Peter the Great and the latter gave it to the emperor of China. Leibniz designed a high-speed car that would travel along the road like a ball bearing, designed drainage in Hartzu mines, a navigation system, utilization of wasted heat furnaces, tax reform, public health services, including epidemic-related, fire protection, steam fountains, street lighting, and state bank. He was even interested in mundane matters such as wheelbarrows or cooking pots. He designed shoes with springs so that he could walk faster.

These ideas and projects were considered in the company of van Helmont.

Leibniz can be considered the last one for whom Lullus' ideas were the direct inspiration of their philosophical concepts and which proved to find a permanent place in the history of science and philosophy.

5. Forgotten Scholars

Even though it may be assumed that Kircher's project knowledge is not taking Leibnizian "thinking machines" as the Lullists understood them. Yes, he built a counting machine with new technical solutions compared to Pascalina. He designed a binary computer. Despite many other ideas, there is no device that would implement Lullus' ideas, as was the case with Kircher. Does he think that the function of the "thinking" machine will be taken over by the counting machine, for which he had a theoretical basis? And that only such a machine will be fit for the purposes that could be served by *ars combin atoria*?

Leibniz seems to have only pragmatic designs, as it was with Pascalina, which Pascal built to facilitate the work of his father, a tax collector, so Leibniz worked to improve human health. Even the famous “Calculemus!” can be interpreted as a tool for achieving social consensus, which was one of the goals that Leibniz set for himself.

Grimaldi, a Jesuit mathematician at the court of the Emperor of China, informed him with a fascinating binary system in the hope that with it he would lead to the conversion of the Emperor and, with him, to the Christianization of all of China [71]:

> Daher, weilen ich anitzo nach China schreibe an den Pater Grimaldi, Jesuiter Ordens, Präsidenten des mathematischen Tribunals daselbst, mit dem ich zu Rom bekannt worden, und der mir auf seiner Rückreise nach China, von Goa aus, geschrieben; so habe gut gefunden, ihm diese Vorstellung der Zahlen mitzutheilen, in der Hoffnung, weilen er mir selbst erzählet, daß der Monarch dieses mächtigen Reichs ein sehr großer Liebhaber der Rechenkunst sey, und auch die europäische Weise zu rechnen, von dem Pater Verbiest, des Grimaldi Vorfahr, gelernet; es möchte vielleicht dieses Vorbild des Geheimnisses der Schöpfung dienen, ihm des christlichen Glaubens Vortrefflichkeit mehr und mehr vor Augen zu legen.
>
> Therefore, because I am writing to China to Father Grimaldi, of the Jesuit Order, the chairman of the mathematical college of the same one with whom I met in Rome, and who wrote to me on the way back to China, from Goa; so I thought it appropriate to inform him of this presentation of figures, in hope, because he himself told that the monarch of this powerful empire is a very great enthusiast of the art of accounting, and also from father Verbiest, the predecessor of Grimaldi, who learned the European way of accounting; that perhaps this depiction of the mystery of creation could serve to give him the ever more glorious Christian faith first hand.

In the Leibniz era, Athanasius Kircher realized the most successful AI project. This theory does not in any way detract from Leibniz's scientific and philosophical achievements. It belongs to those thinkers to whom are sometimes attributed more. An example is the case of Leibniz's contribution to the development of modern logic. According to Peckhaus [105]: The development of modern logic in the UK and Germany in the second half of the 19th century can only be explained as an unconscious first, and only later a conscious reference to the Leibnizian program. Hence, the assessment of the importance of Leibniz's logic for the development of modern logic must be greatly relativized. In another previous work, Peckhaus wrote [103, p. 436]:

> The development of the new logic started in 1847, completely independent of earlier anticipations, e.g., by the German rationalist Gottfried Wilhelm Leibniz (1646 – 1716) and his followers [104], [102, ch. 5].

The question is why Kircher's work has been forgotten. A similar question can also be posed in the case of Leibniz, who was already forgotten during his lifetime, reflected in that his funeral was attended only by a personal secretary. Although he was a member of the Royal Society and Königliche-Preußische Akademie der Wissenschaften, none of these institutions honored him in any way in connection with his death, and his grave remained forgotten for more than 50 years.

Athanasius Kircher had a Catholic funeral, which was solemn. His heart was deposited in a church in Santuario della Mentorella. In 1661 Kircher found the ruins of that church, which he thought was from the days of Constantine. Kircher, by his own accord, had it rebuilt. What caused Kircher's to be forgotten for three centuries? How did it happen that “a giant among seventeenth-century scholars” and “one of the last thinkers who could rightfully claim all knowledge as his domain” [19, p. 68] fell into oblivion for three centuries?

Descartes declared Kircher more a charlatan than a wise man and as someone with an aberrational imagination. The pretext for such opinions was Kircher's description of the experiment with plant heliotropism, which apparently was not understood by Descartes. Kircher pointed to the magnetic link between the Sun and plants by experimenting with a sunflower floating in the water on cork. When the flower was spinning behind the Sun, the clue indicated the time. Kircher, as the reason for the inaccuracy indicated, blocked the attracting light through glass, which protected against the inaccuracy that the wind could cause. Descartes interpreted Kircher's description as referring to earlier speculation that attributed the heliotropic properties of sunflower seeds floating in a cup of scale. Although Kircher described experiments with other heliotropic plants, Descartes stayed at his side and launched an unbridled attack on Kircher. Descartes' authority in the emerging science according to a rational paradigm was so great that Kircher's reputation was permanently damaged. Even Nicolas-Claude Fabri de Peiresc (1580 – 1637), a longstanding supporter of Kircher, became suspicious. Despite his criticism, Kircher maintained his version of the sunflower clock, occasionally modifying and demonstrating its proper functioning. In the *Magnes, sive de arte Magnetica* (1641) [1] he noticed that this kind of clock works only a month, even when it is nurtured with the greatest care – nothing is perfect in every aspect.

In the *Mundus subterraneus* (1678) [60] Kircher writes about various creatures that live underground, including dragons, in which he believed himself as the last scholar. Rationalists are less spontaneous, but Kircher was also on the right track to recognize microbes as the cause of disease, to discover the rules of volcanism and even to formulate some prototheory of evolution.

Huygens in the letter to Descartes [24, vol. III, p. 802] of January 7, 1643 makes a marginal and disrespectful mention of Kircher's magnet[18]. In response Descartes reads [24, vol. III, pp. 803-804]:

> Je sais bien que vous n’avez point affaire de ces gros livres, mais affin que vous ne me blasmiez pas d’employer trop de temps à les lire, je ne les ai pas voulu garder d’avantage. J’ai eu assez de patience pour les feuilleter, et je croy avoir vû tout ce qu’ils contienent, bien que je n’en aie gueres leu que les titres et les marges.
>
> Le Jesuite a quantité de forfanteries, il est plus charletan que sçavant. Il parle entre autres choses d’une matière, qu’il dit avoir eu d’un marchand Arabe, qui tourne nuit et jour vers le soleil. Si cela etait vrai la chose serait curieuse, mais il n’explique point quelle est cete matière. Le pere Mersenne m’a ecrit autrefois, il y a environ 8 ans, que c’etait de la graine d’heliotropium, ce que ie ne crois pas, si ce n’est que cete graine ait plus de force en Arabie qu’en ce païs, car ie fus assez de loisir pour en faire l’experience, mais elle ne reussit point. Pour la variation de l’aimant, i’ai toujours cru qu’elle ne procedait que des inégalitez de la terre, en sorte que l’aiguille se tourne vers le coté oú il y a le plus de la matiere qui est propre à l’attirer: et parce que cete matière peut changer de lieu dans le fonds de la mer ou dans les concavites de la terre sans que les hommes le puissent savoir, il m’a semblé que ce changement de variation qui a eté observé à Londres, et aussi en quelques autres endroits, ainsi que raporte votre Kircherus, etait seulement une question de fait, et que la philosophie n’y avait pas grand droit.

> I know you have nothing to do with these books, but because you don't blame me for spending too much time reading them, so I didn't want to keep them anymore. I had enough patience to review them, and I think I've seen everything they contain, even though I've only drawn attention to their titles and indications on the margins. This Jesuit has a lot of child in him and is more a charlatan than a scholar. Among other things, he talks about an issue he claims he received from an Arab merchant who turns day and night toward the Sun. If that were the case, the matter would be interesting, but it does not explain at all what this is about.
> My father Mersenne wrote to me in the past, about eight years ago, that these are heliotropic seeds, which I don't believe, except that this grain has more strength in Arabia than in this country, because I had enough time to do the experiments, but I didn't. As for the deflection of the magnet, I always thought it was only from the unevenness of the earth, so that the needle rotates in the direction where the most matter is, which is suitable to attract it; and because this matter could change its place on the seabed or in the concavities of the earth, which people cannot know, it seemed to me that this shift in deflection observed in London, and also in several other places, as Kircher reports, was only a matter of fact, and that whole philosophy had little to do with it.

Kircher knew Descartes' opinion. A. Baillet, the biographer of Descartes [24, vol. IV, p. 413] writes:

> Le Pére Kircher ne fut pas long-temps sans changer de sentiment à l'égard de M. Descartes, dont il rechercha l'amitié par la médiation du P. Mersenne; et M. Descartes, outre des compliments et des recommandations de lui, reçût encore ce qu'il avait écrit de la nature et des effets de l'aiman, et y fit quelques observations qui se sont trouvées aprés sa mort parmi ses papiers.

Father Kircher soon changed his feelings to Descartes and via father Mersenne sought friendship with him; but Descartes, in addition to compliments and advice given to him, continued to sustain what he wrote about the nature and operation of the magnet, and made some observations that were found after his death among his documents. One more negative review is included in the letter to Colvius [24, vol. IV, p. 718]:

> Il y a longtemps que j'ai parcouru Kirkerus; mais je n'y ai rien trouvé de solide. Il n'a que de forfanteries à l'italiene, quoi qu'il soit Allemand de nation.

> It's been a long time since I've read Kircher, but i didn't find anything solid there. There is nothing there except childish tricks of Italian, although he is German.

Perhaps not only Descartes' opinion, but also the spirit of the age contributed. Also Descartes, who was another Jesuit educator, equated Jesuit intellectualism with the Inquisition that imprisoned Galileo and sentenced Giordano Bruno [52, pp. 95-96].

Why, four centuries after Kircher's birth, was there interest in his person and creativity? Is it because of eccletism and some similarity to postmodern thinking? [39, p. 272] explains a reason:

> his effort to know everything and to share everything he knew, for asking a thousand questions about the world around him, and for getting so many others to ask questions about his answers; for stimulating, as well as confounding and

inadvertently amusing, so many minds; for having been a source of so many ideas—right, wrong, half-right, half-baked, ridiculous, beautiful, and all encompassing.

6. Conclusions

With the person and achievements of Gottfried Leibniz, the time of shaping the idea of artificial intelligence is over, and the history of artificial intelligence begins. From Leibniz the way leads to Turing not only when it comes to the universal computer [21], but also when it comes to artificial intelligence. Leibniz believed in its implementation. He wrote [77, p. 664]:

> I should venture to add that if I had been less distracted, or if I were younger or had talented young men to help me, I should still hope to create a kind of universal symbolistic [spécieuse générale] in which all truths of reason would be reduced to a kind of calculus.

The development and applications of AI change our lives as Leibniz wanted, when he wrote that it would be (*characteristica universalis*) the last effort of the human spirit, because when the project is implemented, the human tool will have the ability to expand the possibilities of reason, just like a telescope that removes vision and a microscope that enabled us to see the interior of nature.

Thanks to it, 'Leibniz an Heinrich Oldenburg' [80, pp. 373-381]:

> […] inter loquendum ipsa phrasium vi lingua mentem praecurrente praeclaras sententias effutient imprudentes, et suam ipsi scientiam mirantes, cum ineptiae sese ipsae prodent nudo vultu, et ab ignarissimo quoque deprehendentur.

> [...] while speaking, with the very power of wording, when the tongue is guided by the mind, even the fools will speak very intelligent sentences, wondering at their knowledge, without difficulty defeating their mental inability, and even the most stupid will understand these words.

We now come to make the judgment that Leibniz called for when he wrote, 'Leibniz an Heinrich Oldenburg' [80, pp. 373-381]:

> Quantam nunc fore putas felicitatem nostram si centum ab hinc annis talis lingua coepisset.

It means:

> Judge how fortunate our happiness will be if, in a hundred years from now, such a language will arise.

For his *machine arithmetica* Leibniz designed a medal with the inscription [3, pp. 307-308][19]:

> SUPRA HOMINEM
> — better than mankind.

However, today as artificial intelligence becomes more realistic, it raises more fears than hopes.

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Notes

1. See [133]. However, GPT-2 is not made publicly available due to possible abuses. An example of text written by GPT-2 can be seen here: https://lionbridge.ai/articles/this-entire-article-was-written-by-an-ai-open-ai-gpt2/ [02.02.2020].
2. Please see the conference materials: July 13-15, 2005, the *Dartmouth Artificial Intelligence Conference: The Next Fifty Years*, https://www.dartmouth.edu/~ai50/homepage.html [20.01.2020].
3. Base de Dades Ramon Llull (Llull DB), please see: http://www.ub.edu/llulldb/index.asp?lang=ca [02.02.2020].
4. The web page of: https://www.csic.es/es/el-csic [02.02.2020], please see also [3].
5. “The Creation, or language, is an adequate subject of the science of Kabbalah […] That is why it is becoming clear that its wisdom governs the rest of the sciences. Sciences such as theology, philosophy and mathematics receive their principles and roots from it. And therefore these sciences (scientiae) are subordinate to that wisdom (sapientia); and their [= the sciences] principles and rules are subordinate to it [= the Kabbalah] principles and rules; and therefore their [= the sciences] mode of argumentation is insufficient without it [= the Kabbalah]” [111].
6. The full sentence is: “Words are wise men's counters, they do but reckon by them: but they are the money of fools, that value them by the authority of an Aristotle, a Cicero, or a Thomas, or any other doctor whatsoever, if but a man” [42].
7. The works by Athanasius Kircher (1602 – 1680) are available here: https://archive.org/search.php?query=creator%3A"Kircher%2C+Athanasius%2C+1602-1680" [02.02.2020].
8. For the web page of the Museum of Jurassic Technology, please see: http://mjt.org/ [02.02.2020].
9. The web page of the Kircher's Museum: https://archimede.imss.fi.it/kircher/emuseum.html [25.01.2020]. Kircher's ethnographic collection is located in Rome, Pigorini, the National Museum of Prehistory and Ethnography.
10. The web page of Museo Galileo: https://www.museogalileo.it//en [02.02.2020].
11. A student of Athanasius Kircher, Gaspar Schott, publishes a treatises on the wonders of scientific innovation, please see: http://www.rarebookroom.org/pdfDescriptions/schioc.pdf [02.02.2020].
12. An appropriate phrase in Latin: *Petrus noster amicus, venit ad nos qui portavit tuas litteras ex quibus intellexi tuum animum atque faciam iuxta tuam voluntatem*.

13. The model of Leibniz-inspired binary machine was built in the years of 2003–2004 by E. Stein and G. Weber, Das Institut für Baumechanik und Numerische Mechanik, Leibniz Universität Hannover.
14. The ternary calculating machine of Thomas Fowler, please see: http://mortati.com/glusker/fowler/fowlerbio.htm [02.02.2020].
15. Similar statements are contained in other texts of the quoted volume, e.g. on pages [75, pp. 26, 64-65, 125].
16. Name is formed from 'LIST Processor.'
17. The web page of Leibniz-Sozietät der Wissenschaften zu Berlin e.V., please see: http://www.leibnizsozietaet.de/ [02.02.2020].
18. For indicating the original texts of Descartes and their translation, and also additional data, I thank Jerzy Kopani.
19.The full note is as follows: "*Excogidad in curru inter Hanoveram et Peinam* 14. October. 1895 G. L. R. *Machina arithmetica cum verbis* SUPRA HOMINEM. [*Nam hominem maximorum calculorum et promtitudine et securitate vincit*.] *Miramur ratio est divina quod indita rebus*: S u p r a h o m i n e m *humana est machina facta manu*. *Quanta Deum fecisse putas hominem super? Ecce* S u p r a h o m i n e m humana *est machina facta manu*."