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Philosophical roots of artificial intelligence: theoretical and practical foundations

ABSTRACT:

The concern of philosophy with the nature of knowledge, reasoning, and consciousness, logic, perception, moral reasoning, etc., has played a pivotal role in shaping the foundations of Artificial Intelligence, and in this way provided the groundwork for computational models and algorithms of Artificial Intelligence systems. While there are several works on the philosophy of artificial intelligence, this paper distinguishes itself by its study on the influence of philosophy on the historical development of artificial intelligence. It particularly focuses on the influences of the works of Aristotle, Leonardo da Vinci, Blaise Pascal, Gottfried Leibniz, Thomas Hobbes, Rene Descartes, etc., whose notions on logic, mathematics and calculations laid the groundwork for AI's computational foundations. For the purpose of achieving the aim and objectives of this paper, it adopted the historical, thematic and hermeneutic methods. The work discovered that the Philosophical enterprise is at the heart of the development of artificial intelligence.

KEYWORDS: Artificial Intelligence, Philosophy, Development, Logic.

RESUMEN:

La preocupación de la filosofía por la naturaleza del conocimiento, el razonamiento y la conciencia, la lógica, la percepción, el razonamiento moral, etc., ha desempeñado un papel fundamental en la configuración de los fundamentos de la Inteligencia Artificial y, de esta manera, sentó las bases para los modelos y algoritmos computacionales. de sistemas de Inteligencia Artificial. Si bien existen varios trabajos sobre la filosofía de la inteligencia artificial, este artículo se distingue por su estudio sobre la influencia de la filosofía en el desarrollo histórico de la inteligencia artificial. Se centra particularmente en las influencias de las obras de Aristóteles, Leonardo da Vinci, Blaise Pascal, Gottfried Leibniz, Thomas Hobbes, René Descartes, etc., cuyas nociones sobre lógica, matemáticas y cálculos sentaron las bases para los fundamentos computacionales de la IA. Para el logro de la finalidad y objetivos de este

trabajo se adoptó los métodos histórico, temático y hermenéutico. El trabajo descubrió que la empresa filosófica está en el centro del desarrollo de la inteligencia artificial.

PALABRAS CLAVE: Inteligencia Artificial, Filosofía, Desarrollo, Lógica.

INTRODUCTION

A cursory glance at the historical development of artificial intelligence shows that there is a strong connection between philosophy and artificial intelligence, which has led to the emergence of a branch of philosophy of mind and the philosophy of computer science that studies artificial intelligence and its implications for ethics, epistemology and consciousness [1]. This field of inquiry addresses fundamental philosophical questions bordering on artificial intelligence in such a manner that no other field of study can address. This area of study now referred to as Philosophy of Artificial Intelligence is based on the connections between philosophy and artificial intelligence.

The nexus between artificial intelligence and philosophy can be established at various points. First, is in the understanding of intelligence, which is the capacity for abstraction, logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem-solving. It can also be defined as the ability to perceive, adapt, modify, extend or infer information [2]. This understanding of intelligence is at the heart of the philosophical enterprise, and also very fundamental to the articulation of the subject area: artificial intelligence. A second area is ethics, given that develop-

[1] MCCARTHY, John, «The Philosophy of AI and the AI of Philosophy». jmc.stanford.edu. Archived from the original. http://jmc.stanford.edu/articles/aiphil2.html, 2018.; MÜLLER, Vincent C., «Philosophy of AI: A structured overview». SMUHA, Nathalie A. (ed.), *Cambridge Handbook on the Law, Ethics and Policy of Artificial Intelligence*. Cambridge, 2023, 22; BRINGSJORD, Selmer and GOVINDARAJULU, Naveen Sundar, in ZALTA, Edward N. (ed.), *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, 2019, 43.

[2] SHARMA, R. R., «Emotional Intelligence from 17th Century to 21st Century»: *Perspectives and Directions for Future Research*. Vision, 12 (1), 2008, 59-66.

ments in the area of AI raises ethical questions requiring a response [3]. Thus, Thilo Hagendorff avers that "Current advances in research, development and applications of AI systems have yielded a far-reaching discourse on AI ethics" [4]. Consciousness is an important topic in the philosophy of mind and of course an important concern in the development of artificial intelligence [5], therefore establishing another point of interaction. At the level of epistemology, a nexus can be established between the two areas, especailly with the need to know the certainty of knwoledge generated by artificial intelligence. Free will is another parameter that connects philosophy with artificial intelligence, given that there is the question of free will on the part of the programmed machine and even on the part of the human person who might suffer an infringement [6].

These connections between artificial intelligence and philosophy has generated the question looming at the horizon of this paper: are there philosophical roots in artificial intelligence? Or better put, has philosophy contributed in any way to the development of artificial intelligence? These questions are the burdens of this paper. And to respond to them, a historical approach is adopted to interrogate the different epochs in philosophy in search of echoes of relationships or philosophical animations of artificial intelligence.

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3 McNamara & van de Putte, «Lead Section, § 1.2 The Traditional Scheme and the Modal Analogies». Ribino & Lodato (2022), p. 3.

4 Hagendorff, Thilo, «The Ethics of Artificial Intelligence Ethics: An Evaluation of Guidelines». *Minds and Machines* (2022), 30: 99-104.

5 Jaynes J., *The Origin of Consciousness in the Breakdown of the Bicameral Mind.* Houghton Mifflin (2000), p. 33; Rochat, P., «Five levels of self-awareness as they unfold early in life». *Consciousness and Cognition* (2003), 12 (4): 717-731; Guertin, P. A., «A novel concept introducing the idea of continuously changing levels of consciousness». *Journal of Consciousness Exploration & Research* (2019), 10 (6): 406-412.

6 Carus, Paul, «Person and personality». In Hegeler, Edward C. (ed.), *The Monist.* vol. 20. Chicago: Open Court Publishing Company (1910), p. 369; Baumeister, Roy F., and Monroe, Andrew E., «Recent Research on Free Will», *Advances in Experimental Social Psychology* (2014), 50: 1-52.

Understanding artificial intelligence

There is no generally accepted definition of artificial intelligence [7], however, it is established that it is a term coined by Professor John McCarthy in 1955, and defined by him as "the science and engineering of making intelligent machines" [8]. The European Commission defined artificial intelligence thus:

> Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications) [9].

According to Vijay Kanade,

> Artificial intelligence (AI) is the intelligence of a machine or computer that enables it to imitate or mimic human capabilities" [10]. Kanade adds that "AI uses multiple technologies that equip machines to sense, comprehend, plan, act, and learn with human-like levels of intelligence. Fundamentally, AI systems perceive environments, recognize objects, contribute to decision making, solve complex problems, learn from past experiences, and imitate patterns. These abilities

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[7] Allen, J. F., «AI growing up: the changes and opportunities», *AI Magazine* (1998), 19(4):13-23; Kirsh, D., «Foundations of AI: the big issues». *Artificial Intelligence* (1991), 47:3-30; Bhatnagar, S., *et al.,* «Mapping Intelligence: Requirements and Possibilities», in Muller, V. C. (ed.), *Philosophy and Theory of Artificial Intelligence.* Berlin: Springer, 2017, 117-135.

[8] Manning, C., *Artificial intelligence definitions.* Stanford: Stanford University (2020), p. 23.

[9] European Commission on Ai, *A definition of Artificial Intelligence: main capabilities and scientific disciplines.* https://digital-strategy.ec.europa.eu/en/library/definition-artificial-intelligence-main-capabilities-and-scientific-disciplines, 2018.

[10] Vijay Kanade, *What Is Artificial Intelligence (AI)? Definition, Types, Goals, Challenges, and Trends in 2022.* https://www.spiceworks.com/tech/artificial-intelligence/articles/what-is-ai, 2022.

are combined to accomplish tasks like driving a car or recognizing faces to unlock device screens [11].

Artificial intelligence (AI) is, therefore, the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from experience [12].

Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to carry out very complex tasks such as discovering proofs for mathematical theorems or playing chess with great proficiency. Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match full human flexibility over wider domains or in tasks requiring much everyday knowledge.[4] Thus, AI is realized by studying how the human brain thinks, learns, decides, and works while trying to solve a problem, and then using the outcomes of this study as a basis for developing intelligent software and systems.

Aristotelian foundations of artificial intelligence

The concern of philosophy with the nature of knowledge, reasoning, and consciousness, logic, perception, moral reasoning, etc., has played a pivotal role in shaping the foundations of Artificial Intelligence, and in this way provided the groundwork for computational

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[11] *Ibíd.*

[12] Onyiah, S. C.; Ndubisi, J. O. E; Kanu, A. I., «Navigating the Ethical Implications of Artificial Intelligence through Carol Gilighan's Ethics of Care». A paper published in *Aquino Journal of Philosophy.* (2024), 4(2)1-12; Kanu, A. I.; Addidi, T.; Kanu, C. C., «Artificial intelligence and cybercrime in Nigeria: Towards an Ethical framework». *Dialogue and Universalism* (2024), 32(1)143-158; Kanu, I. A.; Pilani M. P. and Omenukwa, P. C., «Philosophy of Artificial Intelligence, Biblical Wisdom and the Exodus (31:1-11) Narrative: Converging Perspectives». *Tuijin Jishu/Journal of Propulsion Technology* (2024), 45(3)3030-3044.

models and algorithms of Artificial Intelligence systems [13]. In the 4th century of the history of Western thought, Aristotle invented the first system of formal logic for the governing of rationality, and thus lead to proper and valid deductions in an argument. The systems of syllogisms developed by Aristotle were the first step toward the basic mechanism that would allow humans to derive conclusions from premises in a mechanical way. This has influenced the development of artificial intelligence despite the historical gap between the time of its invention and the period of the emergence of artificial intelligence [14]. This is important when viewed from the perspective that Artificial Intelligence systems use algorithms to process information, make inferences, and draw conclusions that find a basis in Aristotle's logical framework for building computational models of reasoning.

Aristotle's Hylomorphism can also be related to the interactions between material and formal causes in artificial intelligence. 'Hylomorphism' is simply a compound word composed of the Greek terms for matter (*hulê*) and form or shape (*morphê*). It is in this regard that Aristotle's view of body and soul is understood as an instance of his thoughts on hylomorphism. In this context, he introduces the soul as the *form* of the body, which in turn is said to be the *matter* of the soul. He treats soul-body relations as a special case of a more general relationship which obtains between the components of all generated compounds, natural or artifactual. In *De Anima*, Aristotle uses the images of the body and soul to explain this. The soul is a "first actuality of a natural organic body" [15]. He added that it is a "substance as form of a natural body which has life in potentiality" [16]. Similarly, it "is a first actuality of a natural body which has life in potentiality" [17], all claims which apply to plants, animals and humans alike.

Aristotle's hylomorphism posits that reality consists of two fundamental principles: Matter: potentiality, material substrate, or raw mate-

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13 PONOVSKI Antonion, *How Did Philosophy Help Develop Artificial Intelligence?* https://www.thecollector.com/philosophy-artificial-intelligence-development,2023.

14 *Ibíd.*

15 *Ibíd.,* ii 1, 412b5-6.

16 *Ibíd.,* ii 1, 412a20-1.

17 *Ibíd.,* ii 1, 412a27-8.

rial, and Form: actuality, essence, or structure that organizes matter [18]. The notions of form and matter in Aristotle were developed within the context of a general theory of causation and explanation, which appears in virtually all his works. This theory holds that when we wish to explain what there is to know, for example, about a house, a complete account necessarily alludes to at least the following four factors: the house's matter, its form or structure, the agent responsible for that matter manifesting its form or structure, and the purpose for which the matter was made to realize that form or structure [19]. These four factors were termed as four causes by Aristotle.

The hylomorphism of Aristotle can be applied to understand the relationship between material cause, which include hardware, algorithms, data, and computational resources (matter), and formal cause, which include software, programming, architecture, and cognitive models (form). The implications this has for artificial intelligence is that it helps to explain how the complex AI behaviors emerge from the interactions between material and formal components [20], and also material and formal causes enhances AI explainability and transparency.

Modern philosophical roots of artificial intelligence

Leonardo da Vinci (1452-1519), a modern philosopher, was the first engineer to design a mechanical calculator in the 15th century. His sketched plans for a calculator was sufficiently complete and correct for modern engineers to build a calculator on their basis [21]. In

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[18] Aristotle, *Metaphysics, Volume I: Books 1-9*. Translated by Hugh Tredennick. Loeb Classical Library 271. Cambridge, MA: Harvard University Press, 1933, VII-VIII; Aristotle, *Aristotle's "De Anima". Leiden; New York: E. J. Brill,* 1994, ii 1, 412a20-1*;* Aristotle, *Aristotle's Physics*. Books 1 & 2. Oxford: Clarendon P.,1970, Bk II.

[19] Polansky, R, «Bibliography». In: *Aristotle's De Anima: A Critical Commentary*. Cambridge University Press, 2007, 555-562.

[20] *Ibíd,* 555-562

[21] Freiberger, P. A.; Swaine, M. R.; Hemmendinger, D., and Pottenger, W.M.«Computer», *Encyclopedia Britannica*.https://www.britannica.com/technology/computer, August 31, 2024.

History of Sciences, his role is of fundamental importance, and has become the basis of many types of studies [22]. In the 17th century, the philosopher Blaise Pascal (1623-1662), at the age of 18, built one of the first working calculating machines known as Pascal Calculator or Pascaline, basing his knowledge on the design of Leonardo da Vinci's mechanical calculator.

He developed the calculator challenged by the laborious arithmetical calculations required by his father's work as the supervisor of taxes in Rouen. Thus, he designed the machine to add and subtract two numbers directly and to perform multiplication and division through repeated addition or subtraction [23]. Between the 17th and 18th centuries, Gottfried Wilhelm Leibniz (1646-1716), built a mechanical calculator that was somewhat more sophisticated than Pascal's. Leibniz's calculator, now known as the stepped reckoner. It could do more than addition and subtraction. It had the capacity for multiplication and take the square root of numbers [24]. This development made Thomas Hobbes to suggest a similar idea in his *Leviathan*: "For what is the heart but a spring; and the nerves, but so many strings, and the joints, but so many wheels." [25] In this, relating the human person to the machine.

The attribution of thinking and understanding to the machines is firmly entrenched in the distinction between dualists and materialists views of the mind in the history of philosophy. Rene Descartes is one

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[22] ISAACSON, W., *Leonardo da Vinci.* Walking, Rio de Janeiro: Publisher Intrinsic Ltda, 23; CLARK, K. (2001). *Leonardo da Vinci.* Rio de Janeiro: Publishing House, 2017, 33.

[23] CHAPMAN, S., «Blaise Pascal (1623-1662) Tercentenary of the calculating machine». *Nature* (1942), 150: 508-509; TATON, René, *Le calcul mécanique. Que sais-je.* France: Presses universitaires de France (1963), 2028; FELT, Dorr E., *Mechanical arithmetic, or The history of the counting machine.* Chicago: Washington Institute (1916), 55; D'OCAGNE, Maurice, *Annales du Conservatoire national des arts et métier, 2e série, tome 5, Le calcul simplifié (in French).* Paris: Gauthiers-Villars et files, Imprimeurs-Libraires (1893), 3; WILLIAMS, Michael R., *History of Computing Technology.* Los Alamitos, California: IEEE Computer Society (1997), 15; BISHOP, Morris, *Pascal, The life of genius.* New York: Reynal & Hitchcock (1936), 65.

[24] KIDWELL, Peggy Aldritch, y WILLIAMS, Michael R., *The Calculating Machines: Their history and development.* MIT Press (1992), 38-42

[25] PONOVSKI Antonion, *How Did Philosophy Help Develop Artificial Intelligence?*

of the well known dualists in the history of Western philosophy [26], and the pre-figurement aspects of the Turing test can be traced to his 1637 *Discourse on the method* in which he writes:

> How many different automata or moving machines could be made by the industry of man ... For we can easily understand a machine's being constituted so that it can utter words, and even emit some responses to action on it of a corporeal kind, which brings about a change in its organs; for instance, if touched in a particular part it may ask what we wish to say to it; if in another part it may exclaim that it is being hurt, and so on. But it never happens that it arranges its speech in various ways, in order to reply appropriately to everything that may be said in its presence, as even the lowest type of man can do [27].

This idea sparked discussions and debates about the nature of consciousness and cognition. In this text, Descartes is noting that machines are capable of responding to human interactions. However, he argues that such automata cannot respond appropriately to things said in their presence in the way that any human can, thus pointing to the limitation of such a machine in relation to the human mind. Descartes, therefore, in this text prefigures the Turing test but also defines the insufficiency of appropriate linguistic response as that which separates the human from the automaton. While it can be said that he fails to consider the possibility that future automata overcoming such insufficiency, his concern was not so much about the future but the present reality around him.

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[26] KANU, I. A., «Anglican Church Men, Descartes and John Locke on Innate Ideas: Religion and Philosophy in Dialogue». *AMAMIHE: Journal of Applied Philosophy*. 12. 1. 91-99, 2014; KANU, I. A., «Personal Identity: Theological and Philosophical Perspectives». *AMAMIHE: Journal of Applied Philosophy*. 13. 1. 1-13, 2015.

[27] DESCARTES, René, *Discourse on Method and Meditations on First Philosophy*. New Haven & London: Yale University Press (1996), 34; KANU, I. A., «African and Western Perspectives on Being in Metaphysics». *AMAMIHE: Journal of Applied Philosophy*. 9. 1. 149-165, 2011; KANU, I. A., «Locke's Agnosticism Of Substance And Orthodox Christian Faith». *AMAMIHE: Journal of Applied Philosophy*. 12. 1. 1-13, 2014; KANU, I. A., «Extra Religio-metaphysical Concept of Freedom and Necessity in David Hume». *AMAMIHE: Journal of Applied Philosophy*. 14. 1. 1-7, 2016.

Contemporary roots of AI in philosophy

The perspectives of philosophers in the contemporary era will be discussed to present the contributions of contemporary thinkers to the development of artificial intelligence and also to express the different faces of artificial intelligence in the contemporary times. These thinkers include, Frege, Wittgenstein, Alan Turing and his Turings Test, John McCarthy and the Dartmouth Proposal, and Allen Newell and Herbert A. Simon and their Physical Symbol System.

a. Frege's Modern logic and the use of Quantifiable Variables

German logician, mathematician, and philosopher Gottlob Frege was a key figure in the development of contemporary logic and analytical philosophy. Many people believe that Frege's revolutionary logical writings symbolize the underlying split between modern methods and the more traditional Aristotelian school. He developed the first completely axiomatic logic system and current quantificational logic [28].

A significant step in the development of both science and philosophy, was the German philosopher, Gottlob Frege's development of modern logic in the late 19th century. He is credited with the invention of modern quantificational logic, and had a huge influence on how philosophical and mathematical logic progressed [29]. He introduced the use of quantifiable variables rather than objects such as people into logic. His novel approach made it possible to express, for example, "Stephen is a College Principal" in a different form such as "there exists

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[28] Zalta, Edward N., «Gottlob Frege», in), Zalta, Edward N. & Nodelman, Uri (eds.), *The Stanford Encyclopedia of Philosophy* (Fall 2024 EditionURL = <https://plato.stanford.edu/archives/fall2024/entries/frege/>.

[29] Frege G., «Anwendungen der Begriffsschrift», *Sitzungsberichte der Jenaische Zeitschrift für Medicin und Naturwissenschaft* (1879) 13: 29-33; Frege G., «Über die wissenschaftliche Berechtigung einer Begriffsschrift», *Zeitschrift für Philosophie und philosophische Kritik*, 81: 48-56. Translated as "On the Scientific Justification of a Conceptual Notation" (1882), 72: 83-89; Frege, G., «Funktion und Begriff», *Vortrag, gehalten in der Sitzung der Jenaischen Gesellschaft für Medizin und Naturwissenschaft*, Jena: Hermann Pohle (1891), 23; Frege G., «Über Sinn und Bedeutung». *Zeitschrift für Philosophie und philosophische Kritik* (1892), 100: 25-50; Frege G., «Über Begriff und Gegenstand"». *Vierteljahresschrift für wissenschaftliche Philosophie* (1892) 16: 192-205.

an X such that X is college principal", while "there exists" is a quantifier, "X" is the variable [30]. This quantificational logic has an important place in artificial intelligence.

b. Wittgenstein's Large Language Model

The field of philosophy has extensively discussed the essence of language, its significance, its connection to the world, and the boundaries of cognition. Wittgenstein, who was a philosopher, mathematician, logician, educator, and architect, stands out as one of the most renowned philosophers in this area, and it appears that there were significant similarities between the implementation of AI and his perspectives on language as presented in the *Tractatus* and *Philosophical Investigations* [31].

Taking the large language models, such as the one that powers ChatGPT, which produces conversational text. They are enormous models, with billions or even trillions of parameters, trained on vast datasets (typically comprising much of the internet). But at their heart, they track and exploit statistical patterns of language use. Something very much like this idea was developed by the Austrian philosopher Ludwig Wittgenstein in the middle of the 20th century: "the meaning of a word", he said, "is its use in the language" [32].

c. Turings Test

The Turing test, also known as the Imitation Game, is named after the English computer scientist, cryptanalyst, mathematician and theoretical biologist, Alan Turing, who pioneered machine learning during the 1940s and 1950s. He introduced the test in his 1950 paper

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[30] Anthony Grayling and Anthony Grayling, *Philosophy is crucial in the age of AI.* https://cio.economictimes.indiatimes.com/amp/news/artificialintelligence/philosophy-is-crucial-in-the-age-of-ai/112233532 (2024).

[31] WITTGENSTEIN, L., *Tractatus Logico-Philosophicus.* Dover Publications; *Wittgenstein*, L. 1953. *Philosophical investigations.* Philosophische Untersuchungen. Macmillan, 1998, 45.

[32] Anthony Grayling and Anthony Grayling, *Philosophy is crucial in the age of AI.*

titled "Computing Machinery and Intelligence" while teaching at the University of Manchester. The test is a method of inquiry in artificial intelligence for determining whether or not a computer is capable of thinking like a human being [33].

Turing proposed that a computer possesses artificial intelligence if it can mimic human responses under specific conditions. The original Turing Test requires three terminals, each of which is physically separated from the other two. One terminal is operated by a computer, while the other two are operated by humans [34].

During the test, one of the humans functions as the questioner, while the second human and the computer function as respondents. The questioner interrogates the respondents within a specific subject area, using a specified format and context. After a preset length of time or number of questions, the questioner is then asked to decide which respondent was human and which was a computer. The test is repeated many times. If the questioner is not able to make a distinction between the responses coming from the computer and that coming from the human person, the computer is considered to have artificial intelligence because the questioner regards it as "just as human" as the human respondent [35].

d. McCarthy's Dartmouth Proposal on Artificial Intelligence

The Dartmouth Summer Research Project on Artificial Intelligence was organized as a summer workshop in 1956 by John McCar-

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[33] GEORGE, B. and GILLIS A. S., *What is the Turing Test?* https://www.techtarget.com/searchenterpriseai/definition/Turing-test, 2023; TURING, Alan, «Computing Machinery and Intelligence». *Mind.* 1950, LIX (236): 433-460; OPPY, Graham and DOWE, David, «The Turing Test», ZALTA, Edward N. (ed.), *The Stanford Encyclopedia of Philosophy*, URL = <https://plato.stanford.edu/archives/win2021/entries/turing-test, 2021.

[34] GEORGE, B. and GILLIS A. S., *What is the Turing Test?*; RUSSELL, Stuart J.; NORVIG, Peter, *Artificial Intelligence: A Modern Approach*. Upper Saddle River, New Jersey: Prentice Hall (2003), 23.

[35] GEORGE, B. and GILLIS A. S., *What is the Turing Test?*; RUSSELL, Stuart J. and NORVIG, Peter, *Artificial Intelligence: A Modern Approach* (2nd ed.), Upper Saddle River, New Jersey: Prentice Hall (2003), 32.

thy a young Assistant Professor of Mathematics at Dartmouth College, and the founder of artificial intelligence, alongside Marvin Minsky, Nathaniel Rochester, and Claude Shannon. Together they created a formidable team of minds dedicated to unraveling the mysteries of artificial intelligence. This event brought together a group of visionaries who sought to explore the possibilities of creating machines that could simulate human intelligence, and is considered founding event and the birthplace of artificial intelligence as a field of study. The summer research project lasted for approximately six to eight weeks [36].

McCarthy organized this group for the purpose of clarifying and developing ideas about thinking machines. McCarthy picked the name "Artificial Intelligence" for the new field. He chose the name partly for its neutrality [37]. This project was funded by the Rockefeller Foundation. The proposal is credited with introducing the term "artificial intelligence". The Project Proposal, with Minsky, M., Rochester, N., Shannon, C.E., as co-researchers, presents its aim as clarifying and developing ideas about thinking machines:

> We propose that a 2-month, 10-man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. 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. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer [38].

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[36] SOLOMONOFF, R. J., «The Time Scale of Artificial Intelligence; Reflections on Social Effects». *Human Systems Management* (1985), 5:149-153; MOOR, J., «The Dartmouth College Artificial Intelligence Conference: The Next Fifty years». *AI Magazine* (2006), 27(4) 87-89.

[37] NILSSON, N., *The Quest for Artificial Intelligence.* Cambridge: Cambridge University Press (2010), 20.

[38] MCCARTHY, J.; MINSKY, M.; ROCHESTER, N., and SHANNON, C. E., *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence.* http://raysolomonoff.com/dartmouth/boxa/dart564props (2006).

The goal of the workshop, therefore, was to explore the possibilities of creating machines that could mimic human intelligence. The attendees were driven by the vision of developing algorithms and computer programs that could perform tasks traditionally associated with human intelligence, such as problem-solving, learning, and language understanding. The workshop's organizers had in mind the vision of a future where machines could replicate cognitive functions, pushing the boundaries of what computers could achieve [39].

At the end of the research, it was concluded 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" [40]. The Dartmouth Workshop of 1956 stands as a pivotal moment in the history of technology and artificial intelligence. It set the stage for the incredible advancements we see today within the parameters of artificial intelligence [41]. In the perspective of Pain Aritria:

> The Dartmouth Workshop laid the groundwork for several key concepts and developments in AI. One of the notable outcomes was the concept of machine learning, where algorithms could improve their performance based on experience. Additionally, the workshop led to the creation of the first AI programs, including the Logic Theorist by Allen Newell and Herbert A. Simon, which could prove mathematical theorems [42].

e. Physical Symbol System of Allen and Herbert

One of the first AI success stories was a 1956 computer program, dubbed the the Logic Theorist, created by Allen Newell and Herbert Simon. Its job was to prove theorems using propositions from *Princip-*

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[39] PAIN A., *Dartmouth Workshop, 1956: The Birthplace of Artificial Intelligence.* https://www.linkedin.com/pulse/dartmouth-workshop-1956-birthplace-artificial-aritra-pain-raqmf, 2003.

[40] MCCARTHY, J.; MINSKY, M.; ROCHESTER, N., and SHANNON, C. E., *A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence.*

[41] PAIN A., *Dartmouth Workshop, 1956: The Birthplace of Artificial Intelligence.*

[42] *Ibíd.*

ia Mathematica, a 1910 three-volume work by the philosophers Alfred North Whitehead and Bertrand Russell, aiming to reconstruct all of mathematics on one logical foundation [43].

A Physical Symbol Systems (PSS) according to Allen, "is a broad class of systems that is capable of having and manipulating symbols, yet it is also realizable within our physical universe" [44]. It operates by taking physical patterns (symbols), combining them into structures (expressions) and manipulating them (using processes) to produce new expressions. It is a machine that produces through time an evolving collection of symbol structures- it initiates processes that is capable of initiating more and more symbol structures usually with some goal.

A physical symbol systems comprises of:

i. Symbols: Symbols include alphabets (A,B,C,D), or numerals (1,2,3,4), or the sounds that we utter, or blanks in a Turing machine. They are usually abstract but the physical symbol system require that they have a physical phenomena, or representations or pattern.
ii. Symbol structures: This is composed of symbols, and can be referred to as combinations of instances of symbols. Symbols can be combined into a word-like structure, which can further be combined leading to larger structures. However, these are done following particular rules.
iii. Processes: This manipulates symbols and symbol structures for the creation of further expressions following a particular logic or rule of expression.

Computers are a kind of a physical symbol system which has:

i. a memory for the storing of symbolic structures;
ii. a mechanism that is responsible for operations on symbolic structures;
iii. a controller for determining which operation is performed at a particular time, this is important as processing is serial.

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43 Anthony Grayling and Anthony Grayling, *Philosophy is crucial in the age of AI.*

44 NEWELL, A., «Physical symbol systems». *Cognitive Science* (1980), 4:135-183.

Allen and Herbert argue that a physical symbol system has the necessary and sufficient means for general intelligent action. What they mean is that, first, any system that exhibits intelligent behavior may be shown to be a physical symbol system. And, second, a physical symbol system, organized well enough, can exhibit intelligence in the same scope as seen in human action [45].

They argue that developments in Computer Science offer strong evidence that support the claim that a physical symbol system, organized well enough, can exhibit intelligence in the same scope as seen in human action. It is in this sense that the field of Artificial Intelligence is viewed as a quest to build computer systems that can exhibit intelligence in the same scope as seen in human action [46].

f. Chinese Room Thought Experiment of Searle

The Chinese room though experiment was developed by the American philosopher, John Searle. His argument simply holds that a digital computer executing a program cannot have a "mind", "understanding", or "consciousness". He begins his experiment with the hypothetical premise: suppose that artificial intelligence research has succeeded in constructing a computer that behaves as if it understands Chinese. The computer takes Chinese characters as input and, by following the instructions of a computer program, produces other Chinese characters, which it presents as output [47].

Suppose, says John Searle, that this computer performs its task so convincingly that it comfortably passes the Turing test: it is taken that

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[45] NEWELL, A., «Physical symbol systems», 135-183; NEWELL, A., & SIMON, H. A., «Computer science as empirical inquiry - Symbols and search». *Communications of the ACM.* (1976), 19(3):113-126; NEWELL, Allen and HERBERT A. Simon, *Computer Science as Empirical Enquiry: Symbols and Sear*ch . http://www.faculty.umb.edu/gary_zabel/Courses/Bodies,%20Souls,%20and%20Robots/Texts/What%20is%20a%20physical%20symbol%20system.htm (1976).

[46] NEWELL, A., «Physical symbol systems», 135-183; NEWELL, A., & SIMON, H. A., *Computer science as empirical inquiry - Symbols and search* (1976), 113-126

[47] SEARLE, John, «Minds, Brains and Programs». *Behavioral and Brain Sciences* (1980), 3(3):417-457; RUSSELL, Stuart J. and NORVIG, Peter, *Artificial Intelligence: A Modern Approach.* Hoboken: Pearson.

it convinces a human Chinese speaker that the program is itself a live Chinese speaker. This is because, to all of the questions that the person asks, it makes appropriate responses, such that any Chinese speaker would be convinced that they are talking to another Chinese-speaking human being. The question Searle wants to answer is this: does the machine literally "understand" Chinese? Or is it merely simulating the ability to understand Chinese? Searle calls the first position "strong AI" and the latter "weak AI" [48].

Searle further supposes that while he is in a closed room and has a book with an English version of the computer program, along with sufficient papers, pencils, erasers, and filing cabinets, and could receive Chinese characters through a slot in the door, process them according to the program's instructions, and produce Chinese characters as output, without understanding any of the content of the Chinese writing. If the computer had passed the Turing test this way, it follows, says Searle, that he would do so as well, simply by running the program manually [49].

He argues that there is no essential difference between the roles of the computer and himself in the experiment. Each simply follows a program, step-by-step, producing behavior that is then interpreted by the user as demonstrating intelligent conversation. However, Searle himself would not be able to understand the conversation as he does speak a word of Chinese. Therefore, Searle argues, that it follows that the computer would not be able to understand the conversation either [50]. This is based on the fact that without "understanding" or "intentionality", what the machine is doing cannot be described as "thinking". More so, since the machine does not think, it does not have a

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48 HARNAD, Stevan, «What's Wrong and Right About Searle's Chinese Room Argument». In PRESTON, J. (ed.), *Views into the Chinese Room: New Essays on Searle and Artificial Intelligence*. Oxford: Oxford University Press (2001), 22; ROBERTS, Jacob, «Thinking Machines: The Search for Artificial Intelligence». *Distillations* (2016), 2 (2): 14-23.

49 SEARLE, John, «Minds, Brains and Programs», 417-457.

50 *Ibíd.*

"mind" in anything like the normal sense of the word. Therefore, he concludes that the "strong AI" hypothesis is false [51].

Conclusion

A cursory glance at the historical development of artificial intelligence shows that Philosophy has contributed greatly yo the development of to Artificial Intelligence.The foundational contributions of philosophy to artificial intelligence are in the areas of Logic and Reasoning: philosophical logic laid the groundwork for AI's computational logic and decision-making. Also in the area of epistemology as the studying of knowledge representation and acquisition informs AI's knowledge engineering. In the area of metaphysics, the understanding reality and existence guides AI's ontology and conceptual frameworks. Within the parameters of ethics, philosophical ethics shapes AI's moral and social implications.

The interactions between AI and philosophy has led to the emergence of key areas in the study of artificial intelligence, which includes: philosophy of mind, involving the understanding consciousness, free will, and intelligence; philosophy of science, involving informing AI's scientific methodology and epistemology; philosophy of language, enabling AI's natural language processing and communication; philosophy of action, guiding AI's decision-making and action. This interactions have not only influenced the development of philosophical areas, but also has influenced the emergence of AI subfields such as Machine Learning, where Philosophical concepts like induction, deduction, and abduction are instrumental; Cognitive Architectures, which is inspired by philosophical theories of cognition; Human-Computer Interaction, which brings in philosophical insights into user experience and interface design, and Robotics, which entertains philosophical questions on agency, autonomy, and responsibility.

Not withstanding the contribution of philosophy to the development of artificial intelligence, and the influences of both studies in the

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[51] *Ibíd.*

areas of the development of key areas of study in artificial intelligence and the developments in the study of artificial intelligence advancing the subject areas in philosophy, the different historical eras in philosophy in this relationship have contributed variously. Beginning with the Ancient period, the works of Aristotle could be described as having provided the basic theoretical foundations for Artificial Intelligence. The theoretical character of the contribution of this epoch is based on the spirit of the ancient era, it was an age that advanced greatly in the development of theories that remains a base for future theoretical developments in philosophy. The Medieval season is not included in this study given that the philosophers of this era more focused on the concerns of theology than science. The Modern and Contemporary Periods made a contribution of a combination of theory and praxis. While thinkers like Descartes is theoretical but others got involved and provided rudimentary practical foundations like Leonardo da Vinci, Blaise Pascal, Gottfried Wilhelm Leibniz and Thomas Hobbes.

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