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Artificial Intelligence

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For centuries before the development of modern robotic and computer science, writers across cultures and continents have imagined in their works a mechanical companion that could perform myriad functions in humans' stead. From famous classical literary figures such as Homer to Isaac Asimov, a penman of the Science Fiction revolution, Artificial Intelligence is an idea birthed from the ink on the page.

Artificial Intelligence, or AI, plays on the penchant for mystery, invention, and godliness that is embedded so deeply in human nature. To somehow understand and manage to emulate the mysteries of life may help us discover more about ourselves, how we came to be, and how our brains operate: to give a "brain" to a machine, something of our own design. From Siri to prosthesis, the advent of Artificial Intelligence seeks to simplify and improve the human experience. In the last few years, robots have steered cars more safely and reliably, and have been developed to assist individuals in hospitals, ensuring the highest possible standards of care. Artificial Intelligence is, to scientists and lay-folk alike, the most tantalizing scientific frontier of the coming century.

AI took root in reality and came to life in the Post-World War II era, a time that saw the almost prophetic budding of computer science as a result of the work done in Alan Turing's life during his time working to crack the Enigma Code. It was after he had gained fame as "The Code-Breaker" that he was invited by the National Physical Laboratory in London to design the world's first computer, inspired by his Turing machine. All the meanwhile, Turing was doing his own work in what can be considered the modern foundation of Cognitive Science. It was his involvement in both the Computer and Cognitive Sciences that opened the door to his theory that perhaps if a machine is "trained" enough, it can "learn" to perform an action repeatedly "on its own." This idea gave rise to the groundbreaking Turing Test, which was used to surmise from certain data and criterion whether or not a machine "thinks".[1]

In 1950, inventor and programmer Arthur Samuel wrote a program through which a computer could play checkers. Computers now can perform automatic functions that put computerized checkers to shame, but at the time, such a program was revolutionary, especially considering the limitations of the programming language and the hardware that were used to write, implement, and run the program. What was truly remarkable, however, was that each time the program ran, the computer was able to save that information and as a result improve its skills in later matches.[2]

The idea of Artificial Intelligence as a palpable and realized field in the hard sciences emerged in the summer of 1956, when Dartmouth professor John McCarthy suggested that he and cognitive scientist Marvin Minsky, who was among the other nine intellectuals invited to participate in pooling their ideas and their brainpower for a summer. In their grant proposal to the Rockefeller Foundation, the term "Artificial Intelligence" was used for the first time. The idea behind this project, in the words of these brilliant minds, "[was] 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".[3]

Following Samuel's work, the next groundbreaking program came from scientists Allen Newell, J. Clifford Shaw, and Herb Simon in 1959. Their invention, the General Problem Solver I, or GPS, was a set of algorithms written with the express purpose of getting a computer to execute logical problem solving. This invention tested both logical intelligence and creativity, making its invention and successful use a true feat. The program was formulated by gathering students as test subjects in a laboratory, giving them problem sets, and asking them to go through the sets out loud as they solved. The algorithms and processes found in the program were modeled after their responses. This was also the first computer program modeled on the idea of incorporating heuristics into the mind of a machine.[4]

During the first half of the 1960's, several discoveries came out of MIT that would further close the gap between the brains of man and machine. In 1961, programmer James Slagle wrote a program called SAINT for his doctoral dissertation that solves calculus problems at the level of a college freshman. SAINT was an especially significant invention because it was the first symbolic integration program ever written. In essence, it was the first program in which a computer became capable of finding the antiderivative for a function; a performance that was of pinnacle importance to almost every future AI breakthrough.[5]

Two years later, in 1963, ANALOGY, written by Thomas Evans, demonstrated that computers can solve the same analogy problems as are on I.Q. Tests. These were classic geometric ratio analyses that involved the thought process of "A is to B as C is to D" in terms of shape and proportion. ANALOGY was followed shortly after by Walter Reitman's Argus, which was capable of solving analogies that were word problems instead of spatial reasoning. This meant that computer programs were approaching an era where they would be almost capable of abstract thinking, drawing parallels between objects that are fundamentally part of the human experience.[6]

Despite how revolutionary the other developments in Artificial Intelligence of the 1960's were, Joseph Weizenbaum's program ELIZA was an Earth-shattering assemblage of code that changed the direction of AI forever. In addition to being one of the first interactive programs, meaning its interface was capable of integrating integration fed to it by interacting with a human being, it was also able to carry on a conversation in the English language about any subject. The program worked by "decomposing," or pulling apart, sentences that were input and using key "trigger" words to formulate an applicable response, much like the human brain does when thinking of how to answer a question or make conversation.[7] With ELIZA an era began that was heavily focused on the development of language coherence, synthesis, and production, a technology computer scientists continue to refine today - most famously in the form of Apple's Siri.

While immense progress over the previous decades had been made, the general public was distanced from AI by a lack of understanding and outreach by scientists to the general public; thus marked the beginning of the first "Winter of AI," which spanned from the start of the 1970's to the early 1980's. Despite a lack of interest and funding in Artificial Intelligence, the field still saw enough progress to produce the First National Conference of the American Association for Artificial Intelligence (AAAI) at Stanford University in 1980. Topics at the conference included system architecture, the impacts of logic and databases, and reasoning of motion.[8,9,10]

There are no foreseeable limits in terms of how far we can take Artificial Intelligence - and how far it can take us - in the future. The forefathers of modern computing and AI have successfully laid the groundwork for a revolution concerning the capacity, performance, and utility of computers. In the words of Nicholas Negroponte, Founder of MIT's Media Lab, "Computing is not about computers any more. It is about living."

References

[1] Hodges, A. (1983). Alan Turing: The enigma. New York: Simon and Schuster.
[2] Buchanan, B. G. (2006). A (Very) Brief History of Artificial Intelligence. AI Magazine, 26(4).
[3] McCorduck, P. (1977). The History of Artificial Intelligence. Address presented at International Joint Conference on Artificial Intelligence. Retrieved from http://ijcai.org/
[4] Newell, A. (1958). Report on a General Problem Solving Program (Rep. No. P-1584).
[5] Barr, A., Feigenbaum, E. A., & Cohen, P. R. (1981). The Handbook of Artificial Intelligence. Stanford, CA: HeurisTech Press.
[6] French, R. M. (1995). The subtlety of sameness: A theory and computer model of analogy-making. Cambridge, MA: MIT Press.
[7] Weizenbaum, J. (1966). ELIZA: A Computer Program For the Study of Natural Language Communication Between Man And Machine.Computational Linguistics, 9(1).
[8] Smith, D. E., & Clayton, J. E. (1980). A Frame-Based Production System Architecture. AAAI-80.
[9] Chester, D. (1980). HCPRVR: An Interpreter For Logic. AAAI-80.
[10] Forbus, K. D. (1980). Spatial and Qualitative Aspects of Reasoning About Motion. AAAI-80.