Review Article ISSN 2771-9057

Recent Advances in Clinical Trials

Artificial Intelligence, An Intuitive Network

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Received: 11 May 2025; **Accepted:** 17 Jun 2025; **Published:** 25 Jun 2025

Citation: Jaime Hinzpeter C. Artificial Intelligence, An Intuitive Network. Recent Adv Clin Trials. 2025; 5(3); 1-2.

Keywords
Artificial Intelligence, Intuitive Computing, Neural Networks, Machine Learning, Cognitive Systems, Human-AI Interaction.

I had just completed a knee replacement operation with Rosa, the hospital assistant robot [1], when a simple question struck me: will I be replaced as a surgeon by AI? (Artificial Intelligence). There's one notable empirical fact: the robot surprises me month after month with its precision. Even though the machine (Rosa) depends on a technical operator today, (in addition to my instructions for marking and cutting), it may one day be completely autonomous. But, let us weave the web, and in order to do so, we need to go back a little further in time.

In the Age of Enlightenment, between 1680 and 1780, in the age of illustration and rationalization, the French philosopher and physician Julian Offray was nearly crucified for his book *Man a Machine.* He affirmed the nature of man and that it is property inherent to matter (decades earlier, Galileo Galilei had also nearly been hanged for theories considered heresies). I believe that the web took shape and color in the first half of the 20th century. Here, two remarkable men appeared: Alan Turing and Kurt Gödel, both mathematicians. They develop similar ideas, albeit with different experiences and styles [2]. Turing, for example, wrote a thirty-seven page article that would begin to change the destiny of humanity. A legacy that reflects the active principles of the computer; an imprint that remains intact to this day: a machine capable of reading, recording, and editing symbols, one after another, in addition to moving in a specific direction [3]. Gödel, for his part, asserted that the rules of the mathematical game are not free from contradiction. This is despite their (apparent) formalism. And of course, 2 + 2 will always equal 4, or 2 raised to the power 8 will equal 256. But, there are complex equations and calculations that, as Gödel demonstrated, cannot be verified, that is, they are undecidable (in other words, truths impossible to deduce from formal rules!). What had to be done, in order to move forward, was to reduce the number of errors and make them more discreet [4]. Errors probably caused by the limitations of classical logic and mathematics (a torpedo to Hilbert's predominant mathematics). Turing, in the gray years after the war and throughout his life, ended up believing that machines possessed intuition and could learn unknown things.

Man, an intuitive machine, what an idea! No one would have thought that the mammoth **ENIAC** computer, weighing 27 tons and with 18,000 vacuum tubes, built in 1943 at the University of Pennsylvania in the USA, had anything resembling intuition. These weren't enlightened or romantic times; they were times of war, a war that had to be won; discovering and analyzing theories, even if they were far-fetched. Calculating too. Some calculations involved great danger (atomic danger, like the Manhattan Project). On the other hand, and in parallel, the Germans weren't far behind.

Is the universe a network of computers?

That's what Konrad Zuse, a German engineer thought (or speculated). He was saved from serving in the Second World War thanks to his studies and skills. He built a computing machine; another mammoth, similar to its American counterpart, the ENIAC. However, it didn't suffer the same fate and was destroyed by Allied bombing in Berlin in 1943. Zuse lived to reaffirm, in 1967, his theory about the vast computer network that is the universe.
The cosmos, yes, as you read… The cosmos is executed by a program.

After the age of fire and the invention of the wheel, the spark of intelligence continued to burn, at least for a group of enlightened

talents: the great physicist and mathematician Stephen Wolfram, on the one hand, and the Hungarian-American genius John von Neumann, on the other. The latter was absorbed in the study and calculation of cellular automata (Neumann was also familiar with the work of Gödel and Turing). Now, simply put, a cellular automaton is a sort of grid like a chessboard, and the value of each square depends on its neighbors (the book Artificial Life by Dr. Eric Goles has descriptive delights for mathematical historians). Von Neumann certainly left us the architectural design of modern computers and their implementation. Stephen Wolfram further maximized the aforementioned by creating software and computer languages (**Mathematica** is the software he authored, launched in 1988). In the early 2000s, Wolfram agreed with Zuse's "peculiar" idea, although he disagreed with the German that there is “nobody” (supernatural) who simulates us as an owner of the "matrix," but that the universe is programmable.

Today, everything is about technology, color, and vertigo, especially from the 2010s onward, leading up to Nobel Prize-winning physicist John Hopfield and his contributions to artificial neural networks and automatic learning [5]. As a notable addition, I can add robotics to the physical manifestation of artificial intelligence (I discussed philosophy and robot development in a previous article).

As the reader will have noticed, rather than tracing the year in which AI was born (which in fact exists, the mathematician McCarthy coined it in 1956), the important thing is to trace its evolution over time, from the manufacturing of vacuum tubes to the silicon chips that are the brains of today's computers [6]. In addition, the development of mathematical theorems and the emergence of very important elements such as: discretization (which was initially limited to values in the range 0-1), the creation of the CPU, reversibility (undoing a mistake in Excel, for example, with CTRL + Z), and of course, automation (for example, when you misspell a word, the computer fixes it). And many more examples…

And if to the latter, (basically mathematics) we add integration with other emerging sciences such as bioinformatics, synthetic biology, and neuroscience, we clearly have a marvel. And of course, without computers, there's no AI [7]. The Renaissance genius Leonardo Da Vinci imagined and created airplanes in his head, but there was no technology.

Will I be replaced? The question still hovered in my head. I typed on my iPhone, but didn't hit enter or anything. And as I wrote this new article, that concern began to lose its strength and unraveled. And, who knows...maybe? Allow me to speculate about speculation [8]. Who knows if AI will change the climate of human emotions, or perhaps even reduce the number of months in the calendar; or it may in the very near future, improve video calls from patients to their treating physicians on cell phones (with a deep learning app that scans the patient online, for example, and uses pixels or other data to pinpoint the exact location(s) of the pain).

I don't think we specialist surgeons will be replaced. I do think there will be other unique and distinctive postgraduate degrees, such as a doctor specializing in bio-algorithm programming or something more imaginative (once again, let me give free rein to my thoughts, like Engineer Zuse) [9]. I think we'll eventually integrate into the network, with more light than shadow, because otherwise, if the shadows predominate, it would be a dangerous unchecked power, a *techno-authoritarian dystopia* (of AI, I mean).

An ideal, luminous network (with ideas “around the sun,” as Galileo said) would be one capable of integrating and creating solutions, not just medical solutions but also new forms of art and culture [10].

AI may one day also win a global literary competition, beating thousands of human participants. Remember that more than 25 years ago, IBM's Deep Blue robot beat Kasparov at a chess game, but unlike that case, here in our fictional literary competition, no one, not even the renowned human judges, noticed that the winning poem was written by... (I think you already know)... an intuitive and intelligent machine.

If Turing were alive, he'd be grinning from ear to ear...

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