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Opinion

AI has a lot to learn from mother nature

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Abstract

This is an opinion paper that demonstrates how much better and more efficient the human brain is than the current Artificial Intelligence implementations. It is thereby inferred that endeavors should be made to emulate the properties of the human brain into Artificial Intelligence software.

Learning from "Mother Nature" is intended to mean applying neurological and psychological properties to Artificial Intelligence software. Artificial Intelligence had its origin by observing the neurological neuron's property of a digital binary input and digital binary output. This led to the logical switch characterization of a simulated neuron [1]. It was discovered that this model had the severe limitation of only being able to simulate linearly separable switching functions. [2]. The unrealizable nonlinearly separable switching functions, for 7 or more variables, are enormously greater than the realizable linear portion. This exceeding difference is demonstrated by the ratio of 4.06×10^{28} (41 octillion) times more functions available than those that can be realized by an AI linear neuron model [3]. The ratio increases more rapidly than exponentially. A human neuron receives an average of 10^3 to 10^4 inputs from other neurons [4]. The startling result is that the percentage of linearly separable functions is essentially zero, for a human's neurological neuron.

Attempts have been made to improve the performance of the linear McCulloch & Pitts neuron model. One attempt was the use of the following function [5]:

$$a_y = \varphi\left(\sum_{i=1}^{n} wi, xi\right)$$

The "φ" represents an activation function of the linear summation (Σ). The activation function's purpose is to include nonlinear separations. Because of the linear summation, "a_y" includes only a fraction of the nonlinear separations. Despite the mediocre improvement, deployed AI systems utilize activation functions. The simulation of neurological properties has basically been abandoned. Rather, deployed applications contain processes devised by human ingenuity and not from neurological principles.

It is important to add that neurological neurons have the capability of synthesizing nonlinear switching functions [6]. Scientists previously thought that solving exclusive OR and other non-linear problems required a whole network of multiple connected neurological neurons. This study proves that individual human brain cells have much more computing

power than experts believed. Biological neural systems have demonstrated that nonlinear separation is possible, and Activation functions are unnecessary.

A means to obtain nonlinear separation was conceived 60 years ago and published a year later [7]. This early work was abandoned, because AI funding was unavailable at that time. Having the choice of work during much later retirement permitted the return to AI research as a hobby. A template has been devised to determine both linear separations and nonlinear separations. It has been proven that the template is able to create separations for any switching function and for any number of variables [3]. Algorithms to use the template is also published [8].

The AI Data Centers are receiving criticism due to their excessive electricity, water, CO_2 pollution, and building size. For instance, medium sized Data Centers consume 5-20 MW [9]. Comparatively, the typical human brain uses about 20 watts [10,11]. Taking the average of the Data Centers power consumption ((5+20)/2=12.5MW) and dividing 20W by 12500000 Watts or about yields 0.00016% of a Data Center's energy consumption. A medium-sized Data Center's water consumption is on the order of 100 million gallons per year [12] or about 273,000 gallons per day for cooling. The human brain actively pumps about half a liter of water from the blood supply into its tissue cavities every day [13]. Considering a half liter to be approximately a pint, the human brain needs 0.0000046% (1pint / (273,000 * 8 pints) of the Data Center's water consumption. The full suite of experiments needed to build and train an AI language system from scratch can generate greenhouse emissions of up to 78,000 pounds of CO_2, which is twice as much as the average American exhales over an entire lifetime [14]. Assuming a week's duration is used in an AI language training and human lives 75 years, a human creates about (78,000/(2*75*52)=10) 10 pounds per week, or about 0.013% (10/78,000) of the Data Center's weekly greenhouse emissions. The average data center is roughly 100,000 square feet [15]. The human brain is smaller than a basketball.

In contrast with Data Centers, the human brain's capabilities and efficiency are astonishing. Obviously, AI researchers have much to learn from the human brain's properties. It is believed that an in-depth neurological study of the human brain will yield emulation insight for more efficient Data Centers.

Another aspect of AI performance enhancement is the expansion of application scope. Current AI applications, which excel in specific tasks like language translation or game playing, are narrow in scope. This means the machine specializes in one area and cannot infer from first principles as humans can ("general AI"). Narrow AI is based on well-understood techniques being exploited commercially [16]. (One can represent the narrow AI by "ANI"). Unlike these ANI applications, a "general AI" can adapt to solve problems in unseen domains, and generalize knowledge, making it a "general-purpose" intelligence rather than a specialized tool [17]. The human brain is such an Artificial General Intelligence (AGI) system. No definitive papers could be found to yield design information for AGI. The papers found only focused on AGI's definition.

Unsuccessful attempts have been made to convert ANI processes to an AGI process. The consensus of top AI researchers is that reaching AGI will be an incremental, collective process built upon entirely new paradigms rather than simply scaling up current Large Language Models (LLMs) [18]. One can consider ANI to be the current AI generation and AGI to be the oncoming AI generation.

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