Life vs. Intelligence: A Brief Comparative Study of Biological and Silicon Stacks in the AI Era

Noah M. Kenney

***Abstract*—Human society has long considered the biological stack to be the only life stack. However, the advent of silicon chips has forced us, or at least some of us, to contemplate the possibility of a second life stack – one composed of silicon instead of cells. Interestingly, this silicon stack is the life stack which humanity has come to fear, though the limitations of either life stack is still unknown. In this paper, we compare the biological and silicon life stacks (and whether "life stack" is the most appropriate terminology), with specific emphasis on the impact of Artificial Intelligence (AI) advancements on the silicon stack.**

I. Overview of the Biological Stack

ALTHOUGH an argument could be made that the biological stack encompasses all living things contained within the biological animal kingdom, the biological stack we refer to for purposes of this analysis is human in nature. Humans are the most intelligent species of those contained within the animal kingdom, though that analysis is in of itself inherently bias, given that the standard of intelligence is a human definition [1].

To understand intelligence within humanity, it is first important to understand that the human body is a unique and intricate design, comprised of both cells and genetic coding, grouped in codons. In regard to the first, the human body contains over 200 types of cells with the most important being: embryonic stem cells, adult stem cells, erythrocytes, granulocytes (neutrophils, eosinophils, basophils), agranulocytes (monocytes, lymphocytes), neurons, neuroglial cells, skeletal, cardiac, chondrocytes, osteoblasts, osteoclasts, osteocytes, lining cells, keratinocytes, melanocytes, merkel cells, langerhans cells, lining blood vessels, lining body cavities, white adipocytes, brown adipocytes, spermatozoa, and ova cells [2]. In regard to the second, the genetic coding of the human body instructs the cell on how to produce specific proteins, and is contained within adenine (A), cytosine (C), guanine (G), and thymine (T), which group to form codons [3]. The amino acids within these codons are essential for human life through the biosynthesis of proteins, and include the following: Valine, Alanine, Aspartic acid, Glutamic acid, Cylcine, Phenylalanine, Leucine, Serine, Tyrosine, Cysteine, Tryptophan, Leucine, Proline, Histidine, Glutamine, Arginine, Isoleucine, Methionine, Threonine, Asparagine, Lysine, Serine, and Arginine, each of which serves an important role in the synthesis of proteins.

One important consideration is how we define intelligence in relation to humanity. Intelligence is often considered cognitive in nature; however, the traditional definition of the word is "the ability to learn or understand or to deal with new or trying situations" [4]. Under that definition, it could be said that individual cells of the human body are intelligent by nature, particularly given their adaptability to outside stimuli, which could constitute a new or trying situation. A notable example of this would be in the ability of the human body to adapt to new virus strands and, in particular, to microbial pathogens [5]. Thus, it is not unreasonable to make an argument that each cell within the human body contains a level of intelligence, regardless of the observability of that intelligence. Collectively, the cells and genetic coding in the human body constitute the living being that is a human.

II. Overview of the Silicon Stack

In 1961, American electrical engineers by the name Jack Kilby and Robert Noyce invented a chip composed of silicon instead of the former vacuum tube technology [6]. The silicon chip ultimately paved the way for integrated circuits, transistors, and the first portal computer. Today, silicon chips are used in everything from smartphones to autonomous vehicles, and silicon wafers are essential to the computing industry [7]. This invention and the use of metal-oxide-semiconductor field-effect transistors (MOSFETs) comprise the fundamental hardware allowing for meeting the computational processing demands of resource intensive systems, such as AI models, deep learning tools, or advanced neural nets [8].

The silicon stack requires logic circuit or firmware to make use the hardware, though we are generally used to interacting with these chips through software and Graphical User Interfaces (GUIs). The intelligence of the chip is only found at this level, and not in the hardware, which contains no adaptive capabilities and is designed only for computational power and thermal energy regulation, particularly through resistor tolerance. This is, in part, because the firmware generally exists in non-volatile memory.

The silicon stack is capable of running complex AI-models, which are generally considered the equivalent of computational intelligence, though in many ways, the goal of computational intelligence is merely to replicate human intelligence. In either case, the intelligence produced is cognitive in nature, most closely mimicking neuron-based brain function in humans.

III. Life Stack vs Intelligence Stack

Some computer scientists, such as George Hotz, talk about the silicon stack as a stack of life, in the same way that the biological stack is a stack of life [9]. However, this characterization relies on us stipulating that intelligence and life are interchangeable terms. The silicon stack does not, and cannot, possess many of the abilities or needs that generally characterize life (ability to break, need for nourishment, etc.). The hardware is not capable of adaptation, and cannot produce its own energy, relying instead on a traditional power supply. Yet, when interacting with an AI model digitally (which is almost certainly powered by silicon), the model may be capable of emulating a human. The language in which is uses to communicate may be indistinguishable from that of a human, and the AI may even be capable of fabricating a backstory, past experiences, and memories. In many regards, these AI models meet or exceed the cognitive processing abilities of human beings, as demonstrated by general knowledge, ability to reason, and memory. Yet, they cannot feel emotion, nor can they experience things in the physical world. Their interactions are limited by the confines of human-computer interaction. Further, the continual improvement of these systems relies on human programming and reinforcement learning, also driven by humans.

The biological stack operates very differently. Particularly through the use of stem cells, the body continually regenerates cells, learns through experiences and interactions with the physical world, and is capable of increasing cognitive abilities over time without human intervention. Thus, it seems best to make a distinction between these two stacks, the biological and the silicon. While the biological stack is a form of life stack, we find it best to consider the silicon stack an intelligence stack – a term we are coining for a system which presents human level intelligence, but no demonstration of life beyond cognitive processing and communication (both language and dialect).

IV. Comparison of the Two Stacks

When comparing the biological stack to the silicon stack, there are several notable points to make.

First, the stack we (humanity) created is the stack we fear the most. This is to say that we have a greater fear of the destruction to come as a ramification of the creation of the silicon stack than we do of the biological stack. Perhaps this is because it is an unknown. Perhaps it is because we sense what it is capable of. Perhaps it is because we subconsciously regret creating it. Additionally, the fears we have of the silicon stack (and AI in particular) are broader than fears we have of the biological stack. We could broadly break these fears into physical dangers, danger of misinformation, danger of polarization – political or otherwise, and the danger of data misuse. If we look for a moment at the biological stack as encompassing all the animal kingdom, we generally find that our fears are isolated. For example, a human may have a rational physical fear of a bear when faced with one. A human may also have a fear of another human, particularly when that other human wields a weapon of some form. Both of these are still categorically isolated incidences. However, fear of AI is generally discussed in terms of wide-reaching impact (i.e., AI destroying all of humanity).

Second, it is important to note that the limitations of both stacks is largely unknown. We do not know the theoretical limitation of a human or an AI model. Regardless, we know that the limitations of the AI model are far greater than the limitations of humanity given that humanity requires rest, nourishment, etc.

An AI model theoretically has no limitation, given the ability to continually increase computational power through increased CPUs, GPUs, and RAM. However, there are currently many limitations of AI models, which include the availability of computationally sufficient hardware, optimized software (including IDEs and kernels), and qualified AI engineers and developers. We could also include in these limitations external factors such as funding and regulation, or even market demand in a capitalist society. Thus, it is important to consider that intelligence of the silicon stack may rival that of the biological stack, but the limitations of the biological stack from a cognitive standpoint will likely soon outweigh the limitations of the silicon stack. Hence, it is critical that we distinguish between the biological stack (a life stack) and the silicon stack (an intelligence stack).

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