THE PROCESSING CONCEPT OF THE BRAIN

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"In IIT, the relationship between the MICS generated by a complex of mechanisms, such as a brain, and the environment to which it is adapted, is not one of ‘‘information processing’’, but rather one of ‘‘matching’’ between internal and external causal structures"
Giulio Tononi 2014 IIT

'There seems to be some confusion as to whether the ordered schemata are derived from sensation or imposed upon them'
Barlow 1959

The commonest starting point is the simple monosynaptic reflex in which a single sensory input controls a single motor output.
Barlow 1959

Introduction

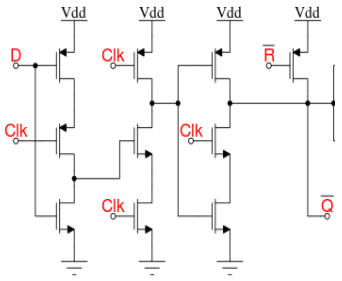
Our senses provide us with huge amount of data to process at each and every given moment. The idea of the brains' capacity to process its entire surroundings constant and massive data stream into a coherent decision-making is no less than mind-boggling. Since the mid-20th century, concepts such as entropy reduction and theory of information were established by scientists, psychologists and philosophers as the basis for brain studies. Those concepts are necessary in order to understand how mathematics can manifest a computation mechanism capable of cognitive-like behaviour.

This paper offers to unify the concept of "active processing" and a reflex, which is considered as a "passive processing".

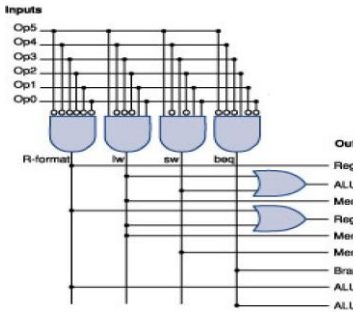
Evolution starts at the same point. All creatures have the same basic concept. If we are to believe that every organic creatures has the same origin we must also conclude a basic and common working method. In this article, we suggest such common method.

Processors vs. simple gates

Is there processing in the brain, or is all just reflex?



1] A CMOS IC implementation of a "true single-phase edge-triggered flip-flop with reset"



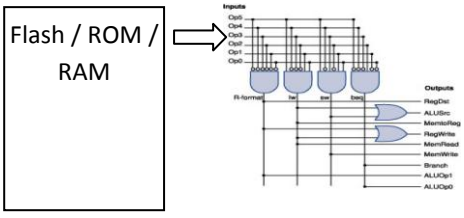
[2] MIPS Processor design

Picture [2] is a simple example of a CPU opcode d sumed as processing, but is it really the case? Let us ask the same question for picture [1], which is a Flip-Flop diagram. This is a basic digital mechanism for assessing multiple inputs into a result on its output. Why is this not considered as processing, or is it? Both answers can be true but the answer entangles both mechanism under the same basic assumption - processing or not, which is merely a terminology issue indeed, but, has to be well defined in order to continue our investigation.

This article first suggestion based on the above assumption is that every process, whether it is cognitive, intuitive or intelligent, is a reflex.

A CPU may also be referred as a **CRU** - Central Reflex Unit

Based on this suggestion, this article will suggest a mechanism that will comply with its rules.



[3] MCU

An MCU has a memory segment to store the code, and from which to generate the data stream into the CRU inputs. This mechanism, as it is, limits the information that this machine can generate under a given code. For every code in memory, there is only its designed amount of

features and it cannot grow new features. However, it can under certain algorithms, gather new data.

With this been said, the same CRU, with its very limited functionality, can serve an unlimited number of code pieces. Those different pieces of code cannot interact, unless given with a pre-defined protocol to comply with. The most common usage that can serve as example for this, are IP connected devices. There are billions of devices connected with IP protocol, but it is obvious that there are many different codes running on those devices. It seems that as a single CRU has finite information to generate, when zooming out and looking on the overall mechanism that it serves in, it produces vast amount of information (yet finite, but dynamic and organic). The logical outcome of the above is that a CRU mechanism and a Network of CRUs do not comply with the same basic mathematical rules.

We suggest here that nature can manifest itself based on a single and very basic set of mathematical rules. The rules themselves are not relevant to this article, but the fact that it must recurs itself through each of its iterations is. In other words, if we will be able to suggest such a mechanism, it will excess the need for different mechanisms.

There is a somewhat strange scenario when a CPU can be viewed as conscious although it is static and can perform only the given code. When a CPU supply voltage drops under the recommended voltage, the CPU hardware goes into a linear mode when every possible value can be considered on every junction in it. The result is a completely chaotic operation that solely relies on environment variables. Although seems irrelevant, this scenario unveils some logical points to consider and that will be addressed here later on.

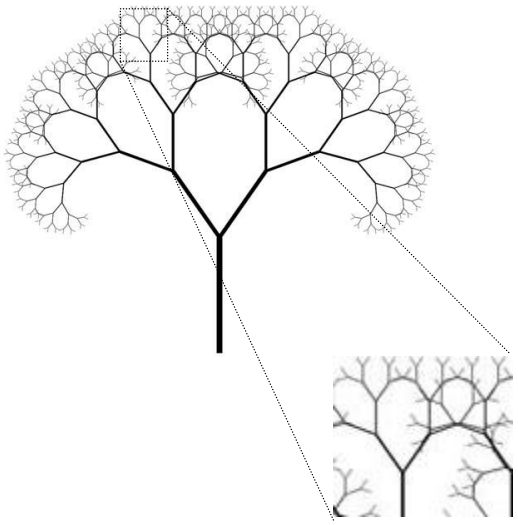
The fact that a CRU is static and not organic determines that its functionality over a given code will always produce the same outcome. The fact that different organic entities produce different outcome for the same input, denies a static CRU structure that is designed by a creator but, this is of course already a given by the materialistic approach. With this, we are left with two possibilities:

- The scheme of the CRU is DNA based
- The scheme of the CRU is self-organizing

For the first possibility to prevail, the scheme of a group of individuals would have to be quite similar with similar outcomes given the same inputs. DNA based fine-tune changes in the scheme scope will result many "bugs" in its functionality. We will suggest, later in this article, a different usage of the DNA code.

If we are to consider the second possibility, we will have to provide with a new method for designing such CRU. There can be no intelligent creator (human) but still, a very complex network has to emerge somehow. Since 1943 (McCulloch and Pitts) ANN were deeply investigated and many designs were introduced. The latest and more prominent is the work of Geoff Hinton who made some algorithmic modifications to improve the networks' functionality. This solution has some inherent mismatches with the brain's hardware when confronted by neuroscientists. For example, ANN has layers, which within those layers there are no neural

connections. Another example from Hinton's work is that the algorithm requires back-propagation which neuroscientist claim as not possible because the network seems to be unidirectional. Some of the ANN algorithms define the need for priors and this is a very crucial matter because it has a big impact on this article practicability.



[4] Fractal tree

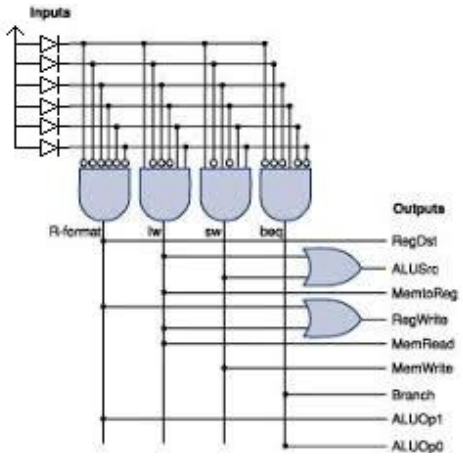
"By "simplicity," I mean reductionism, in the sense that most physicists understand it: the ability to explain as many phenomena as possible with as few laws as possible. This was always been, and still is, the goal of modern physics."
(Mario Livio, Brilliant Blunders)

A fractal system can be a good candidate as a mathematical system that is recursive, and each and every iteration of this system complies with the same basic set of rules. There are endless fractal systems with different basic rules but all of them are recursive all the way.

With those assumptions we must conclude, and if only for this article, that each natural iteration has the basic rules of the whole system - Evolution.

Although the World Wide Web is a network with vast information capacity, it also contains features. Features are what enable the Web to function as an information system by enforcing the basic rules on its data transfer. Some of the features are routers, main servers, maintenance protocol, end-nodes and more. Features are responsible only for the "nature" of the web. UDP protocol is sufficient for simple video/audio transfer but for much more secure and robust data, a TCP interface is required. IPv6 provides additional possibilities to the network over IPv4. Those are just two simple examples of what is a feature.

If we are to consider the MCU as a vast information generator, we will need a mechanism that will enable the code to be dynamic.



[5] Dynamic input data

Diagram [5] shows the same CRU from diagram [2] with one exception. Instead of having a digital opcode interface for memory integration, we connected each input to a photodiode. This is exactly the same CRU with the same features, but with this scheme, it serves as a reflex machine to its environment, much like the under-voltage CPU.

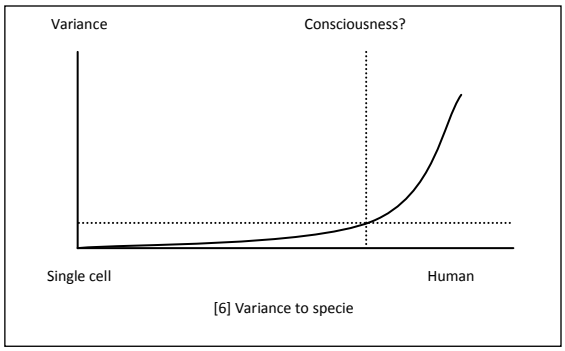
Babies and young children seem erratic, uncontrollable and never able to be static and even can be viewed as "noisy". Can it be that a child cannot sit still because he just cannot? Is it possible that he is not in full control of his body yet, although it seems to us grown-ups that he is old enough?
This paper considers all cognitive and non-cognitive capacities to be divided into features were every feature is an autonomous learning machine that has to "grow" itself and in time to "grow" an interface for interaction with other features. This could explain why a young child cannot fully control his body while resting. He may have "grown" the output feature and can even walk and run perfectly when in focus, but the interface is not complete. Every minor glitch of the focus, every minor interference or change in the visual, auditory or physical feeling will reflex directly to the output in a very coarse manner through a very limited interface. In time, the interface "grows" to enable much more fine-tuned control of the output and allows the child to gain full control.
A good example for this is "Acquired taste" which is often associated with food or beverages that has to be experiences several times before one can differentiate and appreciate all of its aspects. When a person first experience wine he can like it or not. At this stage there are only the main properties of the wine that can be evaluated (general taste, alcohol level, dry or not etc.). Furthermore, first experienced 10$ wine can taste the same as 100$ wine and no one can dispute this absolute subjective declaration. At this stage both cheap and expensive wines may be experienced exactly the same since the relevant interface enables only basic property analysis. Yet, repeated experiences are not enough to expand the interface. In order to enable new interface properties, one must be aware of the possibility of obtaining a new property, and this gap of knowledge can only be triggered by someone else that possess this knowledge. This can also resemble growing emotions to another being.

Features with features tables

Much of this article is a "system design overview" of the organic reflex system, from a logical and not necessarily deterministic point of view. With that approach, we look at this system and try to project its high-level functionality on its possible low-level mechanism.
As such system getting more complex (single cell -> human) we find higher variance between single entities in the same species.

It is very important first to consider the variance parameter when trying to understand the system.

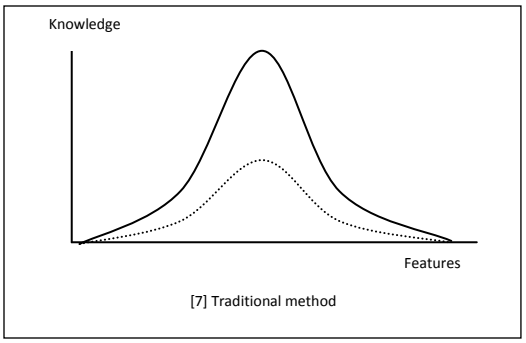
Regular CPU always has the same basic HW features and therefore its variance factor is 1. One will not be able to identify a specific CPU just by watching it working, but there is a possibility of identifying a specific dog for example, just by its "character".



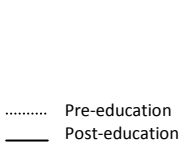
[6] Variance to specie

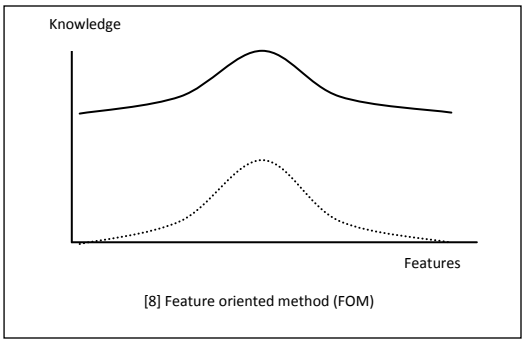
We suggest that observed consciousness cannot exist with a variance factor less than a specific threshold (diagram [6]). However, all species are no more than a CRU, both conscious and unconscious.

If this is the case, we have to evaluate the variance factor and "break it down" in order to map and understand its components. We offer the term Features as the definition for the variance factor components since this term is much more understandable. Therefore, the variance factor projects on the overall number of features for specific specie. We can, and maybe have to, understand the different possible features as it can assist with understanding some of the paradigms that some people possess, but, we have to tackle it with great care since the variance factor is what defines us as superior specie. We can improve education for example by creating a list for each individual of what features he possesses and what is the "strength" of each feature. That way we can create a method for information infusion specific for each individual by using his specific strengths instead of using the same method for everyone. The downside of this proposal is that this method can, in time and if used at the wrong stage, decrease the variance factor and jeopardize the fine structure of the human species.



[7] Traditional method



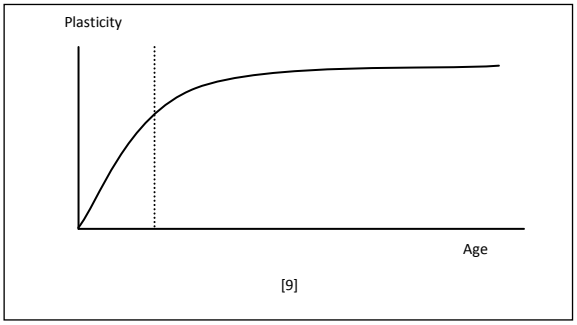


[8] Feature oriented method (FOM)

Diagram [7] and [8] emphasis the benefit of the Feature oriented method (FOM) where the overall knowledge is the integral of the solid-line plot. With traditional method, individuals with features that most correspond to the education method itself will gain the most knowledge where individuals that are outside of the center will gain knowledge with accordance to their

features standard deviation. On the other hand, FOM tailors the education method to the specific features of an individual; thus, the knowledge plot is much flatter. If applied correctly, the result is more individuals with the same final knowledge but with different views, which is a key feature for knowledge growth of the whole specie and also, amplifies the variance.

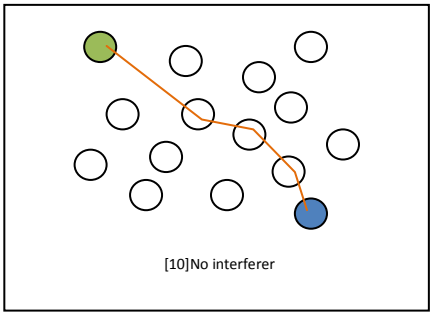
Every organic CRU system undergoes two main growth stages. The first stage is absorbing data from its environment into a raw matter and forms its main structure and the basic features that it may use in the future. The second stage is adding more refined data on this structure, where the available raw matter is reduced dramatically. Gaining new data onto the system during this stage is less and less simple and moreover getting this new data to be functional. In order for new data in the second stage to be functional, the previous data that was functional for a given scenario has to fade out at least to a point where it is "weaker" than the new one.



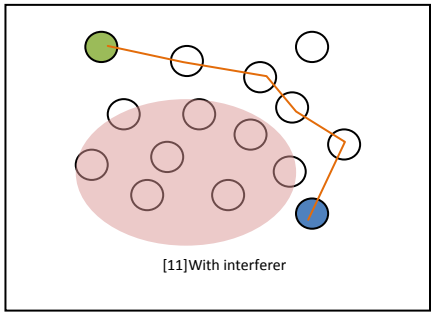
[9]

A possible downside of the FOM is that if applied early in the first stage, it can dramatically reduce the specie variance since at that stage the features are being formed. If we will target a specific feature at this stage, we will in fact create a copy of our own feature. In some scenarios, this downside can become an upside if a specific feature detected as faulty.

Giulio Tononi has long suggested the Φ factor of a qualia as a possible representation for consciousness. We offer to add the variance factor to determine a more precise threshold for consciousness.



[10]No interferer



[11]With interferer

Diagrams [10] and [11] demonstrates a MESH network ability to self-heal and re-route according to a given environmental scenario. The Φ of a MESH network may suggest of consciousness since it is adaptable and dynamic and every given scenario depends on the environment and the networks' previous state. In diagram [11] it is noticeable that the given pattern actually mirrors the environment. In a theoretical very dense MESH network we will actually be able to get a very clear picture of the energy signature in the networks' filed, much like an fMRI snapshot of the visual cortex can indicate the image that the eyes perceive. We

must conclude if a MESH network is either conscious or just a simple CRU. By evaluating the variance factor, we can check two identical networks operation with the same environmental setup. The network has only one feature, which is relaying a message from node to node. It is one-dimensional qualia and therefore has a variance factor of 1. Both of the networks will react at the same in this experiment. This is also the case for ANNs where it may contain a vast amount of junctions and data but it is still one-dimensional.

So what consciousness is? Being different thus having gaps to fill.