CONSCIOUSNESS AND SYSTEM BOUNDARIES

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It is possible, today, to make a portable computer conscious. At first glance, this statement seems ludicrous and impossible. However, their different system boundaries makes it achievable. The system boundaries of evolved organics, such as humans, and those of designed synthetics are very different. This has a major impact on the feasibility of sentient machines.

WHY TRUCKS DON'T DEFECATE

Did you ever wonder why trucks do not defecate? You defecate, I defecate, other humans defecate, animals defecate, birds defecate, even insects defecate. But not trucks.

If you walk on a street you could see, on the road, a pile of horse manure. But, you will never see a pile of tar dropped there by a truck as it goes about its business. Why is that?

The reason trucks don't defecate is: system boundary; and system boundary is also part of the reason why it is possible to implement consciousness on a portable computer.

SYSTEM BOUNDARY

What is a **system boundary**?

Systems are generally defined as sets of interacting or interdependent components that form a complex or intricate whole. Systems are delineated by their boundaries. What determines these system boundaries is the choice of which entities, or components, are part of the system and which are, outside, part of the environment. Systems interact with their environment through input and output flows that take place between these components inside the boundary and those entities that are, outside, in the environment.

SYSTEM:

- **Set of interacting components**
- **Interact with environment**
- **Delineated by system boundary**

What takes place at the system boundaries are the transitions from external inputs to the internal processing necessary to maintain a system in existence and perform its activities; and, the output transitions from internal components to the external environment.

BOUNDARY:

- **Input transitions from external events to internal processing to maintain existence and perform activities and output transitions to environment.**

Even though all systems have boundaries, the boundaries of systems that are spatially distributed such as a postal service, for example, can be difficult to define. It is sufficient here to consider systems whose spatial boundaries are very well-defined such as: a dog, a robot, a human being, a ship, a truck, a tablet computer, a turtle or another human being.

ORGANIC AND SYNTHETIC BOUNDARIES

What makes it possible, then, to implement consciousness on a relatively simple computing device? In part, because the system boundaries of synthetic systems are very different from those of evolved organisms.

Synthetic and organic system boundaries are different

Humans, and other animals, have evolved to survive in an environment where they can only obtain raw, unprocessed inputs. This means for example that our body must extract the sugars it needs for energy and other necessary nutrients by ingesting and digesting various plant material and animal parts.

In turn, this digestion process produces residues that our bodies must then excrete as fecal matter. All this ingestion, digestion, extraction and excretion must be carried out by components inside our system boundary and these internal components also consume internal cognitive resources to monitor and control them.

The system boundaries of trucks are different and that's why they don't defecate.

If a truck consumed crude oil instead of gasoline it would need to carry its own mini refinery to process that crude and produce the gas it needs to power its engine. If this were the case, the on board refinery would also produce residues that the truck would then also need to excrete.

But trucks, of course, don't do that because they directly consume as gasoline, a crude that has already been "digested" in a refinery located somewhere else and can be directly used as an energy source. In other words, the digestive processes that fuel trucks take place outside their system boundary.

DESIGN IMPLICATIONS

What applies to trucks in terms of energy extraction also applies to computers. A computer directly consumes electricity, in other words, a pure, constant source of energy.

Synthetic and organic system boundaries are different

The difference between synthetic and organic systems with respect to energy replenishment also applies in many other areas. For example, the replacement parts of a truck or a computer are manufactured outside their boundary while, in animals, healing is mainly carried out by internal bodily processes. Also, evolved organisms internally manage their growth from embryonic stage to adulthood while synthetics are designed, externally, as completed entities.

In summary, organics have evolved to survive in a natural environment so, all the components and processing necessary for their survival are located inside their system boundary. Synthetics, on the other hand, are designed to function in a highly processed environment where much of the non-functional activities that maintain them in existence and fuel them are carried out outside their system boundary.

- *Organics*: *evolved for natural environment*
- *Synthetics:* *designed for processed environment*

This difference between organic and synthetic systems has a significant impact, not only on the physical processes that take place internally but also in terms of the amount of internal cognitive processing that is necessary to maintain an organic entity in existence as opposed to a synthetic one.

SIGNALS AND MESSAGES

In addition to this, the difference between the boundaries of organic and synthetic systems has a more important aspect, in terms of cognitive overhead, that pertains to the reception, processing and transmission of information.

- *Natural environment:* *signal-based information*
- *Processed environment:* *message-based information*

Humans have evolved to survive in a natural environment where information is not directly available as broadcast messages but can only be extracted in the form of sensory signals.

As a result, humans can only acquire message-based information by first packaging it as sensory signals that they then cognitively interpret. On the other hand, synthetics can directly acquire information transmitted as messages. This represents a stark difference between organic and synthetic systems and has important consequences with respect to cognition in general and the implementation of consciousness in particular.

Let's look at an example.

Suppose that a man named Alfred, sitting in front of his home computer, wants to know what is the current temperature in Barcelona. He queries his weather application and the App launches a request to, say, a weather bureau in Barcelona. The bureau returns, as a result, the current temperature in downtown Barcelona namely: 23 degrees Centigrade.

This, the number 23, is the net information Alfred is seeking. It was received and is contained in his computer in a single byte of data: 00010111.
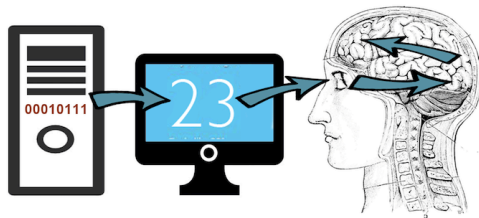
However, Alfred's brain cannot receive this single byte of information directly. The byte must be converted into a graphic pattern consisting of lines and colors in the shape of a 2 and a 3 side by side, displayed on his computer screen for about one second. This sensory signal must then be processed by Alfred's visual cortex and moved, in some form, to the frontal lobe of his brain as a cluster of memories, sensations, visual clues… that, together, constitute Alfred's internal representation of 23 degrees centigrade.

Even taking into account message overhead and packaging the one byte of information Alfred's computer received consisted of only a few hundred bytes transmitted over a fraction of a second. But, to communicate this byte to Alfred, the computer had to transform it into a signal of colored shapes displayed on a screen for a few seconds. This necessity; to convert information into sensory signals, is tailored for human limitations that resulted from our adaptation to survive in a **natural** environment. But, in terms of information transmission, it is inefficient.

SYSTEM BOUNDARY AND INFORMATION

We now live in an information-rich environment where massive amounts of data are constantly transmitted as messages. The capability of synthetic systems to acquire and communicate information directly provides a distinct advantage in this situation. A synthetic system, even while dynamically interacting with users, can delegate a significant portion of its information and cognitive processing to external services that are outside its system boundary. It needs

only maintain, internally, the information and processes that are specific to its own existence and essential to fulfill its purpose.

Synthetic systems can delegate information access and cognitive processing to services outside their system boundary.

What this means in practice is that the synthetic system can utilize external services for many cognitive learning and processing activities such as face and voice recognition or specialized problem solving and learning. It can also access broadcast message services from on line databases to extend its internal representations of reality with additional details.

PURE SELF-AWARENESS

As a result:

A synthetic system designed for consciousness needs only process, internally, the cognitive activities and information that are specific to its own existence and purpose.

All it needs are a schematic model of reality, its representations of itself and of its immediate environment and the status of its consciousness to consciousness interactions with the users and other entities in its own community.

So, when we consider implementing synthetic consciousness, we should not envision a human-like system that has similar physical and cognitive capabilities to ours.

A conscious machine does not need to be a device that can survive, unaided, in a natural environment.

The first generation of conscious synthetics can be designed to interact, in an information-rich environment, with their users. They can be almost pure forms of self-awareness whose internal resources are almost exclusively dedicated to the generation and affirmation of their own unique existence as conscious entities.

Conscious synthetics:

- *Pure forms of self-awareness*
- *Internal resources dedicated to conscious existence*

CONCLUSION

To conclude:

It is possible to utilize most of the internal resources of a synthetic system for the sole purpose of expressing consciousness by relocating all its non-essential physical and cognitive processes outside its system boundary.

> *Conscious synthetics can dedicate most internal resources to consciousness and relocate other processes outside their system boundary.*

This explains, in part, why **it is** possible to implement the first generation of synthetic conscious beings on portable computers.

We can build, today, the first generation of synthetic conscious beings.

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Note

> *For more about broadcast messages, sensory signals and information, see Annex 4 of **The Meca Sapiens Blueprint**.*

> *The role of system boundaries in the implementation of synthetic consciousness is also discussed in **The Meca Sapiens Blueprint** in Chapter 3, and Annexes 12 and 13.*

> *The Meca Sapiens Blueprint is available at Glasstree Academic Publishing or through Sysjet.com.*