

# The Limits of the Simulation of Cognitive Functions and the Supernatural

## -Artificial and Human Perception-

(on February 27th, 14:30)

Thanks very much for this great invitation to IRCAM.

I am truly delighted to be here!

Please allow me to present myself very brief:

I am a German/ Italian - US based, artist working on the intersection of Art and Science, and I am particularly interested in the new aesthetic options to make art with cutting edge science and technology throughout the means itself and its combination with arts.

The today's topic is :

*Artificial and Human Perception*

*-The limits of the simulation of cognitive functions and the supernatural –*

As a visual artist I am particular interested in vision, of course in all it's connotations, but here we discuss its literally meaning, - means: how human perception has triggered artificial mimicking of various visual functions in the area of AI facial recognition – technology, or in the attempt to build self-driving cars, which demands to handle very complex visual tasks. Vision, which seem so effortless and easy to us, is enormously complex and difficult to generate artificially. This becomes very apparent for example with respect to ***invariant object recognition***: The rapid and accurate recognition of objects in the presence of strong variations such as size, rotation and position, distortion and disruption is a very substantial challenge for computerized machines.

The human eye is definitely not a camera.

In 1867 the German physicist Hermann von Helmholtz formulated the idea of “perception as “unconscious inference”. It requires a virtual machine, a computer with a specific software, that could parallel and mimic those “thinking” activities by modeling such inferences.

An important step on this pathway happened in the early 1950s when two scientists recorded neurons in the visual cortex of a slightly anesthetized cat, as they moved a bright line across its retina. They found that the visual field underlays a topographical map with a very specific cell architecture in the visual cortex. In essence cells are only sensitive to very specific type of triggers and these small chunks of information are then assembled in the cortex.

Neural networks in deep learning are very much inspired by this approach. They break down *any type* of information input to very small micro parts. In the field of vision this means to numbering gray scales, color values, contrast and edges, that can be assembled to geometrical shapes, for example, allowing for pattern detections and assembly in the outcome. Opposed to rule based logic AI, in which the programmer dictates every step to one single outcome, deep nets copy the human brain as the basic processing not in strictly logical sets of 0 and 1's but they rather deal with the manipulation of mathematical probabilities.

While the system starts out random it is then trained on the most likely range of accurate results by adjusting the strengths of their connections through so called weights and biases, which are mathematical numbers and functions.

Now we are ready for the supernatural ! Let me present you my artwork *The Prayer* currently on view here in Centre Pompidou: (Here some views)

*The Prayer* is an art-installation that tries to explore the supernatural through artificial intelligence with a long-term experimental set up. A robot – installation operates a talking mouth, that is part of a computer system, *creating and voicing prayers, that are generated in this very moment by the self-learning system itself*, exploring 'the divine' the supernatural or 'the noumenal' as the mystery of 'the unknown', using deep learning.

For the artwork we used a neural language model to learn the probability distribution, a mathematical function, over a sequence of words from text corpora.

We assembled a large religious text data base of all 7 major practiced religions. We merged all data into a kind of "One God or One Religion" data base.

The system infers word meaning and grammar rules from word distribution, by encoding this information in a mathematical structure (as so called tensors in a vector space) which is then utilized to generate natural language. The deep network is fine-tuned on sacred texts, and as such it abstracts key features from this specific genre to generate original prayers, with their peculiar lexicon and syntax. But of course you can train the model for any type of text.

We also use Text-to-Speech (TTS) synthesis, the artificial transformation of text to audio through machine learning in real time. Also in this case voice is decomposed to sound within a mathematical structure (a Fourier transform) into its constituent frequencies along with the text.

*(TTS, processes prosody and voice synthesis at the same time, which results in a more fluid and humanlike voice.)*

But does an AI machine understand what it speaks, hears, voices, predicts and in the artwork prays for?

I show you here a video of the artwork *The Prayer*, while praying.

I want to emphasize, that what you see here performed in the video are the original creations of the AI machine, you do NOT hear some pre-taped text!

## 1)PLAYING VIDEO 1. -

and Video 2 Singing - in addition a brief anticipation of AI singing with free AI generated texts. PLAYING SINGING.

To bring the topic to the point more drastically and provocatively with the perspective on the supernatural: **How would a divine epiphany appear to an artificial intelligence?** The question may sound far-fetched but the focus of the project could maybe shed light on the difference between humans and AI machines in the debate about mind and matter. It reflects on the potentials and implications of deep learning AI within both its narrow, task oriented setting, and a general human-like-state of intelligence. Such an AGI would imply the ability of “common sense” understanding, that like us, allows to apply intelligent approaches to any subject matters.

In such a perspective the installation could maybe touch on a potential principal limitation of AI learning concerning any capacities of **understanding** a subject matter. Such a potential limitation would manifest most obviously and in particular in holistic cognitive activities like religious observance and the creation of art.

There are specific reasons why I focused on the supernatural:

1)

First: What is the point of a religion if there is no subject that feels, experiences and is aware of its own limitations? God and believer seem to disappear entirely in one “go”, without any such inner life. The existential frame of birth and death can be understood as the profound reason and very basis for the adoration and submission to a higher being. To be religious is obviously demanding a conscious being or an intelligent subjective structure that somehow creates understanding of the world and the believer’s own boundaries within it. Consciousness is the bottle-neck for any biological system to perceive, experience and behave in any way intelligent.

But while a subjective conscious inner life would still be mandatory *for a machine* to be religious, the question is whether consciousness would be still the bottle-neck for intelligence, “living” on other substrates as silicone, graphene or carbon nanotubes.

Also keep in mind: Nature created us, intelligent beings, unconsciously.

2)

The second aspect is this interesting perspective on belief as it seem to fall into two each other opposing categories. It has in addition a specific connection to statistics and probability:

Belief can be seen *in ascend or increase of knowledge* as well as *opposed to knowledge*.

Belief does allow to have a certain type of information in order to avoid to have to know everything at once obviously.

One could even state: If a computer will exceed human talents it must learn to believe by calculating probabilities.

Interestingly the neuronal structure embedded in the probabilistic mathematical matrix of deep learning processes seems to allow for both.

AI produces stunning results, that caused its media hype but AI can be also fooled very easily and can produce almost superstitious results, that present human coded biases

as well as prejudices and misinterprets drastically because it runs short of any understanding.

3)

My third consideration is this:

The current essentials of the most advanced processes of deep learning, in the so-called hidden layer structure, are not well understood. They turn out to be some kind of a black box. Do we give up the “dare to know” as the major privilege we have in the entire evolution?

This slogan of human enlightenment expresses the separation from religious dogma, empowering the individual. It proceeds hand in hand with the scientific revolution and the famous scientific method of producing testable evidence allowing for falsification. It clearly outlines the attempt to understand the universe by the physical laws of nature. But already now we do not even understand how an AI produces its results in the hidden layer structure of machine learning.

The question is whether and how a machine ever could surpass our general intelligence - as predicted from many scientists in the field, paired sometimes with certain strong concerns as expressed in the so called ‘control problem’ – and whether such an AI can be like us in any conscious state?

The questions to start an answer are several of which I would like to name a few:

Are all states of mind computable at some point along any future development including emotions and gut feelings?

Is consciousness a natural consequence or maybe even only an epi-phenomenon of a certain degree of complexity of information processing? Does it demand a certain degree of complexity of connectivity in a hierarchical architecture to solve computational tasks like the brain does?

Is quantification the means that underlies what we perceive as qualia: the direct subjective vivid stream of thoughts and experience, as well as the to us most present diversity and qualitative variety of the world around us?

Any potential answer seems to involve also the question what mathematics really is on any fundamental level.

When water became transparent or sometimes also it is claimed – when animals entered land from the sea - there was a great new evolutionary challenge: The situation allowed for overseeing a distant scenery. This opened up *options of actions* and asked to plan and evaluate to act strategically in different ways, pushing for reflection. This is this hypothetical space of the mind, that reached in humans the for now unsurpassed state of intelligence: humans can reflect in abstract models on the world and mirror themselves within it.

The new “electronic transparency” of AI allows to reach out much further and deeper into “the unknown”, detecting subtle patterns and combinations in vast and complex amounts of data, transfer information and draw precise predictions, we could never see and draw on our own without AI technology. For now the results are still read out by us.

This could change in the future or it doesn't: Such potential "quantum leaps" of mankind could come at a high price. The exponential increased influence of AI technology in almost all areas of life could at some point evolve into "higher powers" as specialists in the field are predicting "the singularity". (Defined as : "a hypothetical future point in time at which technological growth becomes uncontrollable and irreversible, resulting in unforeseeable changes to human civilization")

Will the ever since the enlightenment strict border and division between science and religion fall in various respects in the future?

You see: One of the main tasks of ART is to ask questions.

Thank you very much for your attention!

*Diemut Strebe*