White Paper

Artificial Intelligence and Customers

When will you see Intelligent Machines driving your contact centre?

Introduction

Unless you have spent the last 36 months on a distant planet (and even then!), You have certainly had the opportunity to meet every day, at the bend of a feature article, an advertisement, or even a slogan, the term **"Artificial Intelligence"**.

Without claiming to be specialists in artificial intelligence as may be *the neurologist Laurent Alexandre* or the mathematician become member of Parliament, Cédric Villani, this document aims only to help you see more clearly **between futuristic and/or commercial speeches**, and no doubt also, the prescribers of the apocalypse, and the others. All of this, of course, as part of what Nixxis deals with in a central way, the **Customer Relationship**.

Elon Musk: 'Mark my words — A.I. is far more dangerous than nukes'

Catherine Clifford | 1:22 PM ET Tue, 13 March 2018

Despite his claims, Elon Musk has invested nearly $ 680M in Neuralink, a company to produce "AI" implants for the brain.

What is artificial intelligence?

In fact, artificial, this intelligence is very little. Indeed, if it is only imitating ***a certain type of functioning*** of the human brain, it would rather be a question of naming this domain of computer algorithmics **"Machine intelligence"**.

We will see later, that the artificial term is mainly used to position this form of intelligence in relation to the one we all know, **human intelligence**. But before tackling the main principles, *a bit of history*.

Brief history of AI

Experts all agree that the beginnings of AI are due in the course of ***the Second World War (1940-1945)*** and more specifically around the year 1943 when two researchers, Mc Culloch & Pitts have attempted to represent in a Boolean way (with 1 and 0, the only language really understood by computers), the **functioning of the human brain** (you can search on the internet: "*boolean circuit model of brain*").

Alan Turing, the famous English mathematician who cracked the code of the Enigma encryption machine of the Nazi regime during the Second World War, followed suit in 1950 by extending the thesis of precedents with his work on **"Computing machinery & intelligence"**. Indeed, Turing noticed in his activities of cracking the machine code, that specific forms of *sequence of characters* came back regularly and that, if we could quickly test the occurrence of these ***"forms" or "patterns"***, with repetitions of words that often appeared in certain types of messages, the code would be easier to "crack" than using ***brute force*** ("brute force": calculations which would consist of calculating all possible combinations of encryption without taking into account these "patterns").

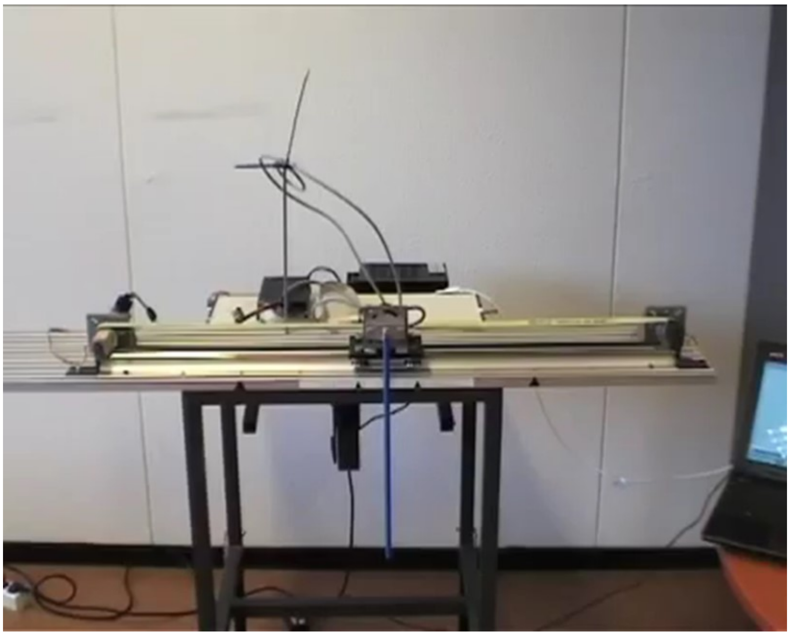
Without wishing to make a complete history of AI, it is important to point out that this already relatively old domain of mathematical algorithmics, has already known what is called a **"winter"**, i.e. a period where we (scientists in fact) *have not been able to advance significantly*.

In fact, at the end of the 1960s, *most of the mathematical models of human reasoning already exist* (see Robinson on *"complete algorithm for logical reasoning"*) but unfortunately, the **computers available** at that time **did not have the power calculation** to verify them.

The first "winter" came in the late 80s/early 90s. The internet is still in its infancy and industrial automation systems offer what will be called **"expert systems"** at the time. These expert systems were, in fact, a way to allow the machine to *learn from its mistakes* and were unfortunately only improved automatisms. In fact, already at the time, it had long boasted power and quality but, again, lack of computing power, it was necessary to quickly resign. In fact, it was quickly realized that *the main challenge of these systems*, was to have not only enough computing power but especially **data** to enable them to l**earn in a time that is significant at the human scale**, that is to say, in days, in weeks or months, and not in ten years or in a century!

Moreover, with the **explosion of the internet** a few years later, all the algorithmic development efforts of the time quickly focused on this "network of networks" (routers, DNS and other IP-related gimmicks).

And so, since about 2010-2011, we can say that with the help of **"Big Data",** the phenomenal **increase in computing power** and the **algorithmic improvement** of the functioning of neural networks, artificial intelligence starts his **2nd spring**!



An interesting video to understand how an algorithm can learn a simple function.

https://www.youtube.com/watch?v=Lt-KLtkDlh8

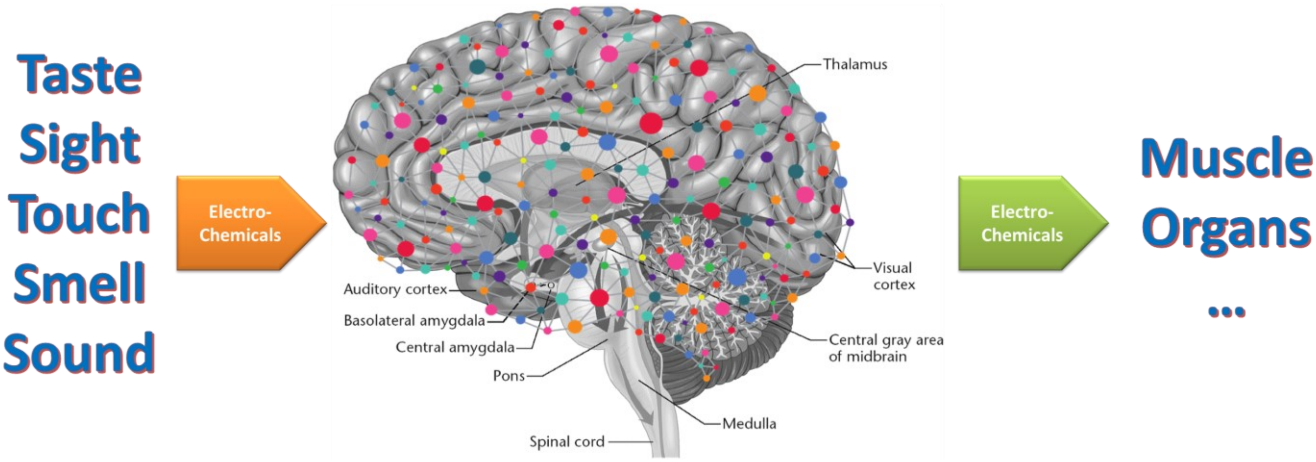
The principle of neural networks

In fact, the algorithmic that is the basis of artificial intelligence or more exactly, of this branch that we call **"deep learning"** is based on the imitation of *how part of the human brain cortex works*: the mesh between neurons and the connections between them called synapses.

Learning to walk for a baby requires a combination of computation and impressive neural connection.

https://www.youtube.com/watch?v=jlzuy9fcf1k

In fact, when you view the two videos above one after the other, you realize that the **learning mechanisms for a machine** that has to maintain a vertical stick according to a given degree of freedom and a baby who must stand straight on 360 degrees, **are quite similar** although much more complex here for the human than in the case of the machine.

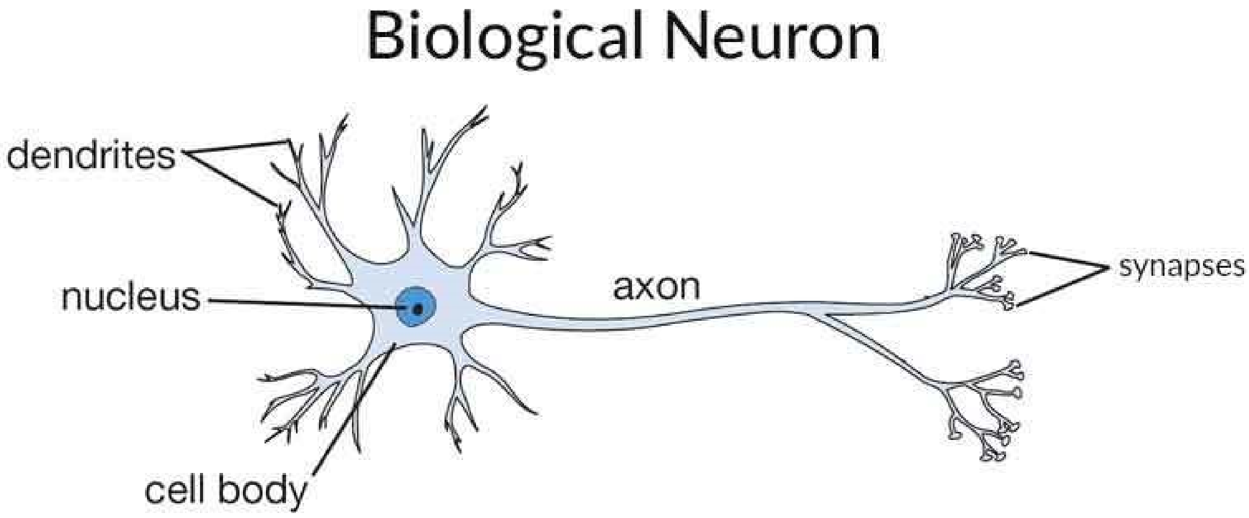


The brain is actually a giant biochemical machine designed to turn stimulations into other stimulations.

The brain receives, on one hand, **electrochemical stimulations** from the five human exteroceptive senses, processes the information, and finally sends other electrochemical stimulations to **muscles and organs**. Of course, this operation described here in a relatively simple way actually uses ***highly complex electro-biochemical mechanisms***.

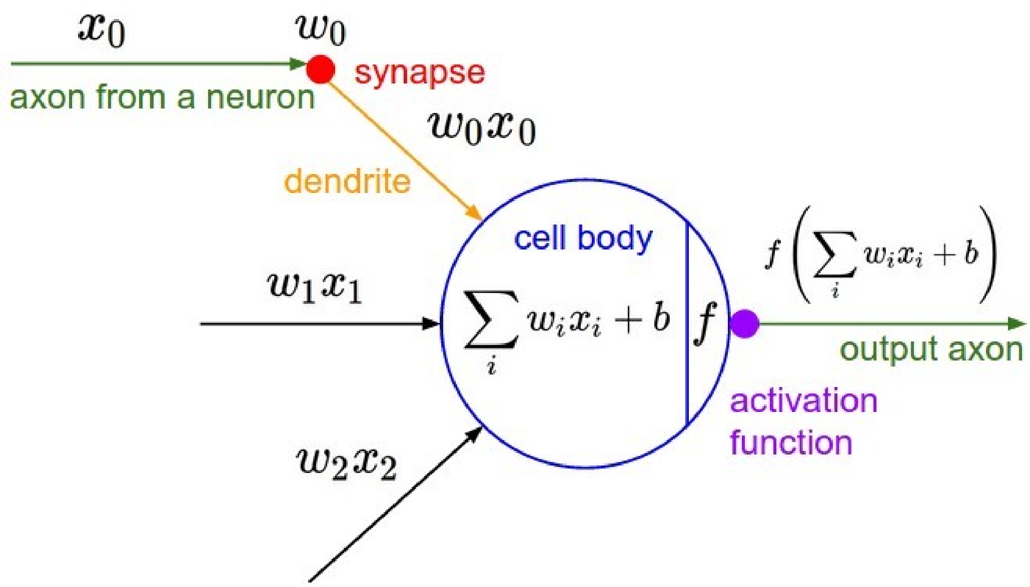
Mathematical neurons

If we go down to the level of the **neuronal cell**, the operation seems much easier to study. In fact, a neuron represents itself with a nucleus and, apart from the mechanisms that aim to feed it with energy, which it consumes a lot by the way since the **human brain consumes 30% of all energy** ingested by the body, it has connections to its peers: **synapses**.



The biological neuron is a stimulus-reactive machine that has taken thousands of years to form.

Obviously, the complexity of the human brain comes from the fact that there are on average nearly **100 billion neurons** in the human brain and they each have 1,000 to 10,000 connections or synapses between them. There are more than **100 trillion (10^{14} to 10^{15}) connections** and potential simulations!



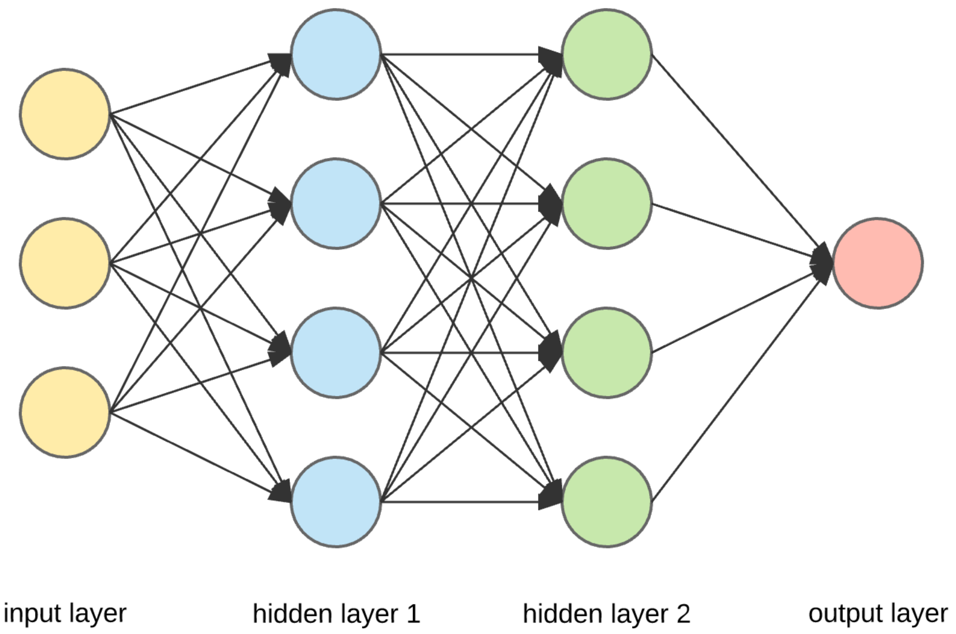
The mathematical neuron is a non-linear function that responds according to the requests received.

From there, the mathematical or algorithmic neuron will actually **mimic the way** the biological neuron works. It will be understood by looking at the diagram above, that the **output function of the neuron f(WnXn)** will react as a function of the stresses Xn received from the other neurons or from the outside world and that the coefficients Wn will determine the **amplitude of the influence** of the solicitation considered on the final result.

You will easily understand that the difficulty of this modelling consists in defining **each of these parameters Wn** and also **the number and the type of connection** between the different algorithmic neurons, knowing that there are hundreds of millions of them!

Deep Learning

"Deep Learning" is therefore the art of associating all these neurons computer to each other so as to obtain an optimal solution between **the amount of stimulation data available**, the **time** and **computing power** needed and **the result** expected of the apprenticeship practiced.



A deep learning structure will have layers of input, internal and output neurons.

We can therefore **draw a parallel** between the way a machine learns and a human will learn. Indeed, if you give a **repetitive task** to a human, generally, he/she will be able to **improve with each repetition**, as for example in the case of learning to play a musical instrument, because it **will learn from its errors** every time and, provided we devote **an equal concentration** to it, he/she will acquire experience, which we will name here, *one of the types of human intelligence*.

A machine that uses *the principles of "deep learning"* can also learn, **just like a human**, and once the structure of his brain is defined, can easily be split, simply by **copying the parameters** of the available algorithms, which is, let's agree, already *much harder with a human*.

One of the difficulties encountered by models of the "deep learning" type is not only to find the **ideal arrangement of the different layers of neurons** and the links between them (computer synapses) but to define, as we have seen above, the **different parameters Wn**.

Several techniques exist to arrive at a result, but one of the most effective that is known is "**back-propagation**". Again, the principle is simple: when you **submit the model to a stimulus** (image or others), it is enough to impose the final result and then *calculate back* in the model, **all the parameters** needed to arrive at the result that you impose. This is called "**supervised learning"**. If the machine can define itself the result to be achieved (like a stick that must be vertical), then we will speak rather of **"reinforced learning"**; because no need for humans to intervene in the learning process.

You will also easily understand here that the **greater the number of stimulations** and results imposed on the output, the **better the learning process** and therefore the *quality of the parameters* associated with the final result.

From there, in the context of the use of AI algorithm, the need for a *large number of data sets* that make **"Big Data"** and **"Deep Learning"** two distant cousins.

Pattern recognition

Just like the human brain, one of the areas where "deep learning" is particularly powerful, is in the **recognition of forms or patterns**. In fact, our brain is also very efficient in these areas as you can see for yourself in the following tests.

Your brain will immediately associate this form in the clouds with a small dog. Strange isn't it?

Indeed, our network's **internal "wiring"** makes it naturally more sensitive to recognition and the association of familiar shapes. Subsequently, cognitive reflexion allows us to differentiate the first impression with the reality, but almost automatically, your brain will have **bound the form** seen to the millions of various forms and all their variations that you will have already observed until then.

You see the butterfly in the middle and the two African women preparing the family meal?

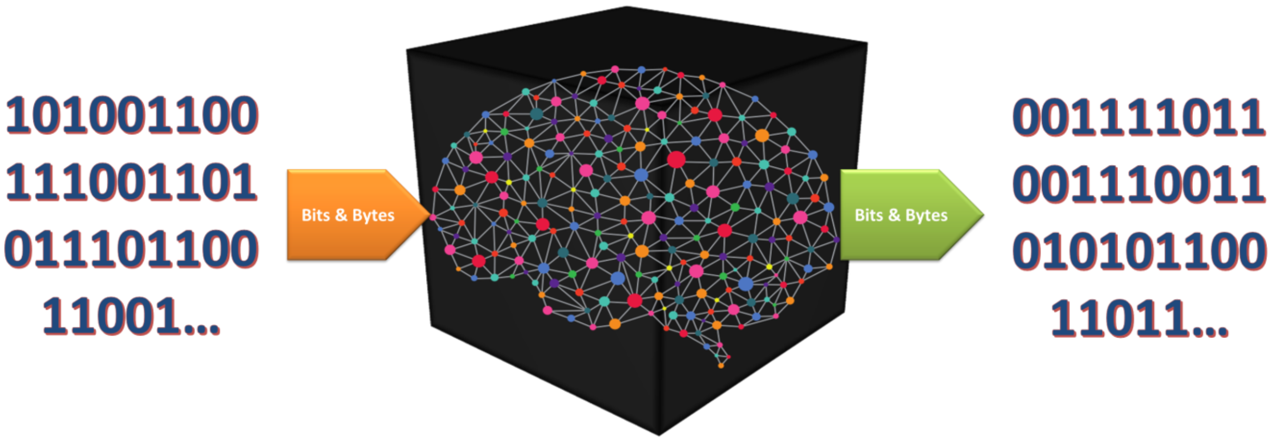
7H15 M3554G3
53RV35 70 PROV3
HOW OUR M1ND5 C4N
DO 4M4Z1NG 7H1NG5!
1MPR3551V3 7H1NG5!
1N 7H3 B3G1NN1NG
17 WA5 H4RD BU7
NOW, ON 7H15 LIN3
YOUR M1ND 1S
R34D1NG 17
4U70M471C4LLY
W17H OU7 3V3N
7H1NK1NG 4BOU7 17.

From the second line, your brain will associate these numbers with characters with similar shapes.

And so, one of the areas where artificial intelligence algorithms are excellent is indeed in the sometimes-complex **recognition of the various forms and patterns** that we will definitively call only "patterns" from here.

Machine intelligence

In fact, as seen above, a computer can **understand nothing but "digital" or Boolean language** and produce nothing but another digital language. Let's consider a continuation of 1 (one) and 0 (zero).

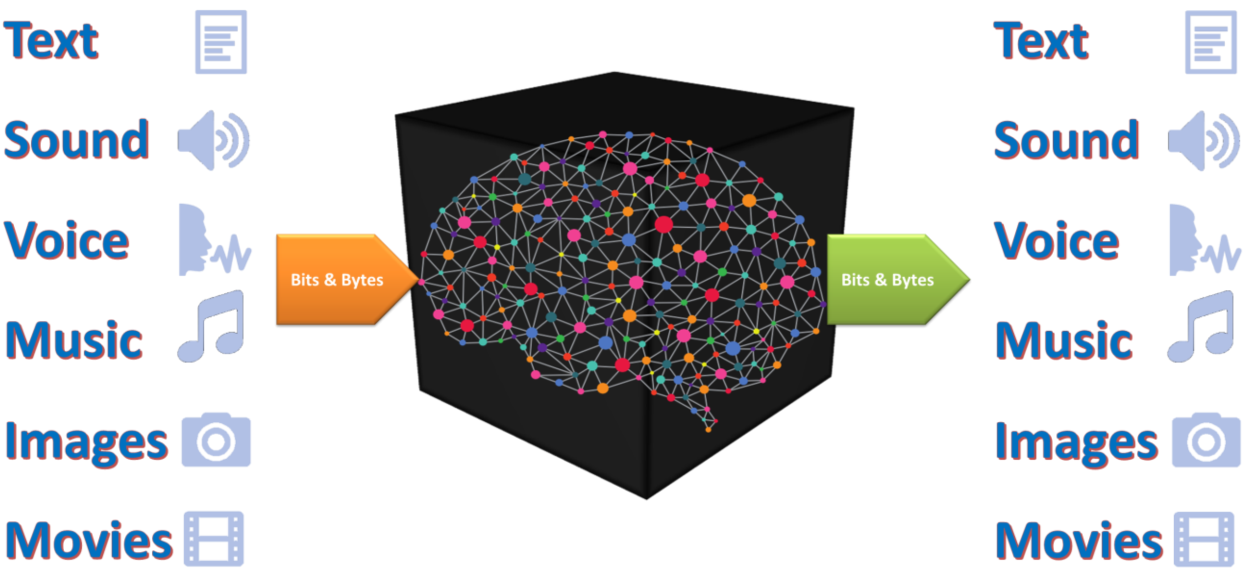


A computer can only understand and produce digital number sequences that are "1" and "0".

If then we digitize the stimulis we already know, we get a **"digital brain"** or rather a *numerical equivalent of a certain type of functioning of the human brain*.

Indeed, if you place yourself from the point of view of a computer, text, sound, voice, image or video music, are only **patterns or specific forms of content** that have been shaped, transformed and adapted by humans to facilitate the understanding to the human brain.

And so, if behind, we ask an AI algorithm to process these data and come out a **digital equivalent** that can be converted into another form of pattern recognized by the human brain, we get a digital equivalent of the brain as you see it in the following figure.

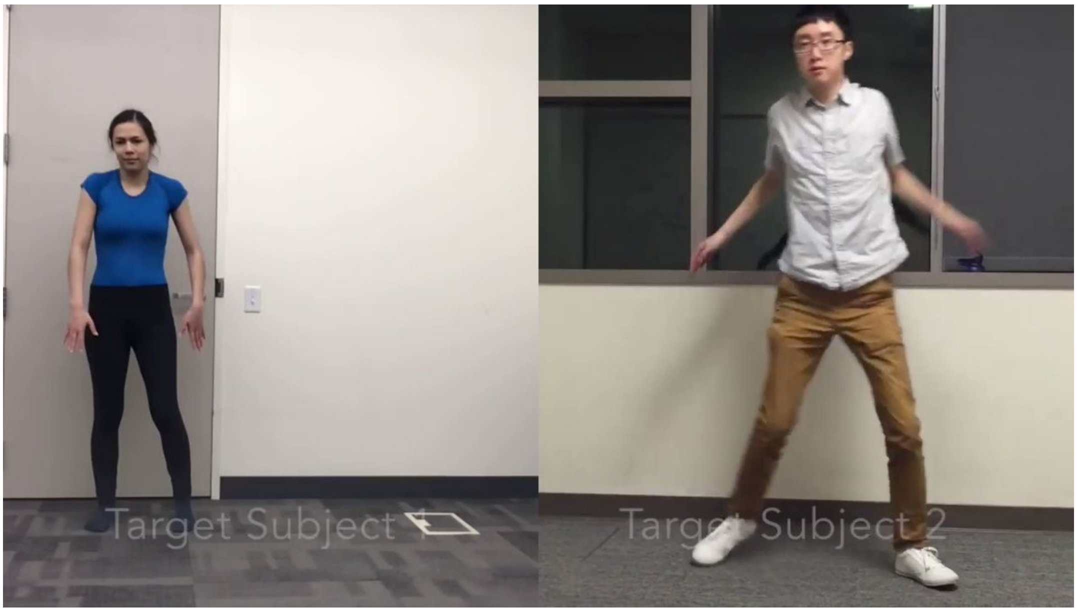


AI algorithm can transform digital stimuli into other digital stimuli understandable to humans.

For example, imagine that you are entering texts in English into a digital brain and that you are programming it via "deep learning" by imposing on the output their **Spanish translations**. After a while, you will get an **English-Spanish text translator** comparable to what "Google Translate" does for example.

Imagine now that you **enter voice** and that you impose text in output. You will then get a **"Speech-to-text" algorithm** that is already well known to call centre users. If you **enter an image** and **output text**, you will get an image descriptor comparable to the one used in the *"MS CoCo challenge"* to test AI algorithm models.

Finally, if you **enter video** and you **come out with video**, you can simply create a complete video sequence as in the famous clip ***"everybody dance now".***



Subjects "calibrate" the algorithm to let it interpret the referent's dance based on their own body.

https://www.youtube.com/watch?v=PCBTZh41Ris

Real Usage in the Contact Centre

In reading the above, you will probably have quickly imagined that this **numerical method of learning to machines the human way of thinking** that we call *"Artificial Intelligence"* has a number of application domain in the call and contract centres. We have therefore tried to list here the **main ones**, although others will surely appear.

Conversation Management

By listening to a conversation in a call centre, everyone will have already noticed that even without knowing the language of the speakers, you can **detect if the conversation is going well or if it goes wrong**. This is because a number of *"universal patterns"* exist as part of a conversation and the emotions or tone employees use are often independent of language, at most, *depending on each other's culture*.

As a result, an AI algorithm can easily **listen to conversations** and define when things were good or bad. By pushing a little further and adding the recognition of language and especially **context and meaning**, we can easily detect not only the signs of annoyance or contentment of the customer but also the reasons for it. Moreover, when a conversation is going well, whether for a sale or a case of helping the customer, the machine can by comparison identify the reasons why the conversation is going well and from a statistical point of view, automatically deduce **conversational best practices** and spread them in real time in the call centre. This is obviously valid for **all media** whether voice or digital.

Sales automation

At a time of speedy **digitalization of marketing**, especially on its **communication** part (advertising i.e. Google & Facebook) and the **segmentation and automation** part (Marketo, Hubspot, Pardot, etc ...), artificial intelligence can deal with *masses of data* that become far too important for one or more human brains.

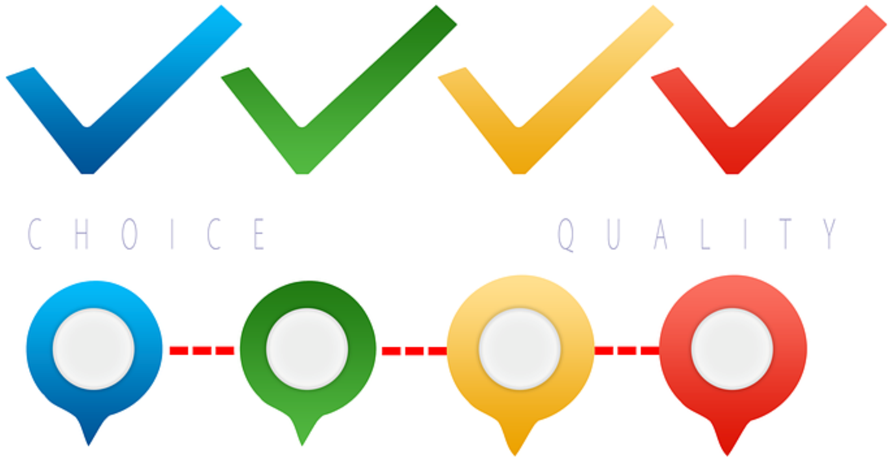
It is indeed very far from the times when segmentation of the market was based on the socio-professional category or the type of use. For example, companies such as *Amazon or Starbucks* moved from a hundred or so segments a few years ago to **more than 400,000 different customer segments**, each time identifying typical purchase mechanisms and especially optimize the marketing mix by using the right media at the right time, the right product offer, etc. With such diversity, there is only one machine that can process this data in order to offer the right mix**.**

In the context of a call centre, whether outgoing or incoming, the *advent of loyalty index like NPS* ("Net Promoter Score") made it possible to realize that "touchpoint " was a moment of truth where the loyalty of the customer, his next purchase, was decided in the moment.

And so, an artificial intelligence that, for a given individual, would have access to all the information, not just about the use of a product or service, but also about the privacy of individuals, could define the **best time to contact a customer** or, if he/she calls us, what is the **best agent profile** to make available to him/her in order to help him/her in the most convincing way.

It is obvious that even if human intervention is and remains at this level the most effective way of helping a client, if we want to generate maximum loyalty from this client, it is important that **the "human" components** is aligned with all the interactions that we may have had with this client and that, an intelligent machine can easily decide.

Quality control



In all contact centres, **trust does not exclude control** (an expression well known to production managers). And so, for each of your campaigns, you are at this stage **forced to sample your recordings** and have them listened by your quality managers to determine if, for example, an agent has co*mplied with the standard phrases of introduction, presentation, conclusions, product value proposition, etc…*

A machine can do this in a more repetitive and constant way and above all, **analyse all of your conversations**, not just a sample of them. We can also go a step further by considering several alternatives and in connection with the segmentation that we saw in the previous point, **propose improvements** and a more **personalized way** of handling the customer's request as a whole.

Security

It is clear that with the digitalization of our identities and our private lives, the security of personal data is and remains **an essential component** of all corporate governance. This is the goal of ***the GDPR regulation***.

Artificial intelligence can therefore define, in a *normal mode of operation*, what are the **normal and acceptable patterns** of use of the sensitive data in order to judge the safety of the latter. When a "normal" operating state has been defined, a machine can then **detect behaviours** that we say are "abnormal" and could potentially **affect overall safety**.

This kind of algorithm is already used for example in public places (station, airport, museum) to define a **normal flow of visitors** or passengers and thus detect any *non-standard behaviour* that would require a human to intervene for verification.

In a call centre, this could be reflected, for example, in the context of the GDPR legislation, if the data that is transmitted both internally and externally by the company is transmitted **in the context of normal use**. and secure or abnormal and requiring intervention.

Products/services usage

Everyone knows that the customer experience in the call centre is only the **"visible tip of the iceberg".** Indeed, telecom operators have understood for a long time that by observing **how a subscriber uses his/her phone** and the numbers he/she calls (support, customer complaints, etc ...), we could **predict the moment** when he/she would join the competition (or "churn" as they say in the trade).

Here too, whether you are marketing a product like a dishwasher or a service like insurance, the **entire customer experience can be digitized** and reported to an intelligent algorithm. Indeed, even a TV or washing machine can today, thanks to the Internet of Things, know if it is **used correctly or not**. Therefore, the algorithm will define the usage profile and from there, define whether to adapt it or involve a human.

Think about the number of times you've had a device or service down and when you call the manufacturer or operator, you have **had to explain** the reasons for your call many times. It's their product or service, *they should know it well before you!*

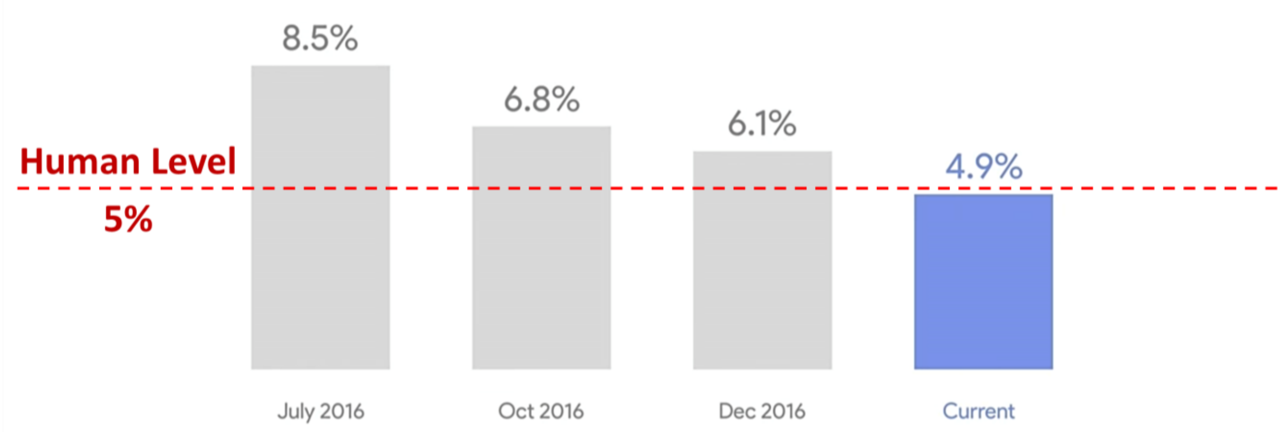
Now in an ideal world, imagine that you buy a washing machine and that *three months after your purchase*, the manufacturer calls you proactively to tell you that the model you bought is undersized for the use you make of it, say you have a 6 kg, and **he offers to replace it** with a more suitable model, say an 8 or 9 kg and this for *free or for a small monthly fixed amount*. **What loyalty would this supplier generate from you?**

Actual limits

If as we have seen above, the promises and application of artificial intelligence, especially in pattern recognition are promising, we must here, however and in all intellectual honesty, moderate some enthusiastic comments often maintained by the "marketing" statements of some of our colleagues. The first moderation will come from the **field of speech recognition** also called **"Natural Language Processing".**

Voice recognition

In early 2017, a big step forward was taken in voice recognition machines. Indeed, the **first algorithms were developed which had a higher performance than humans** in word recognition that is to say an **error rate lower than 5%** which is the average rate of the human being in the English language.



Machines recognize words better than humans, but do they understand the meaning of words?

In fact, what is quite amazing to this extent is that humans have, on average, an error rate of comprehension of one word out of twenty words heard, *which seems really high*. One can therefore wonder how come there are no **more misunderstandings** with such poor recognition of words from human beings?

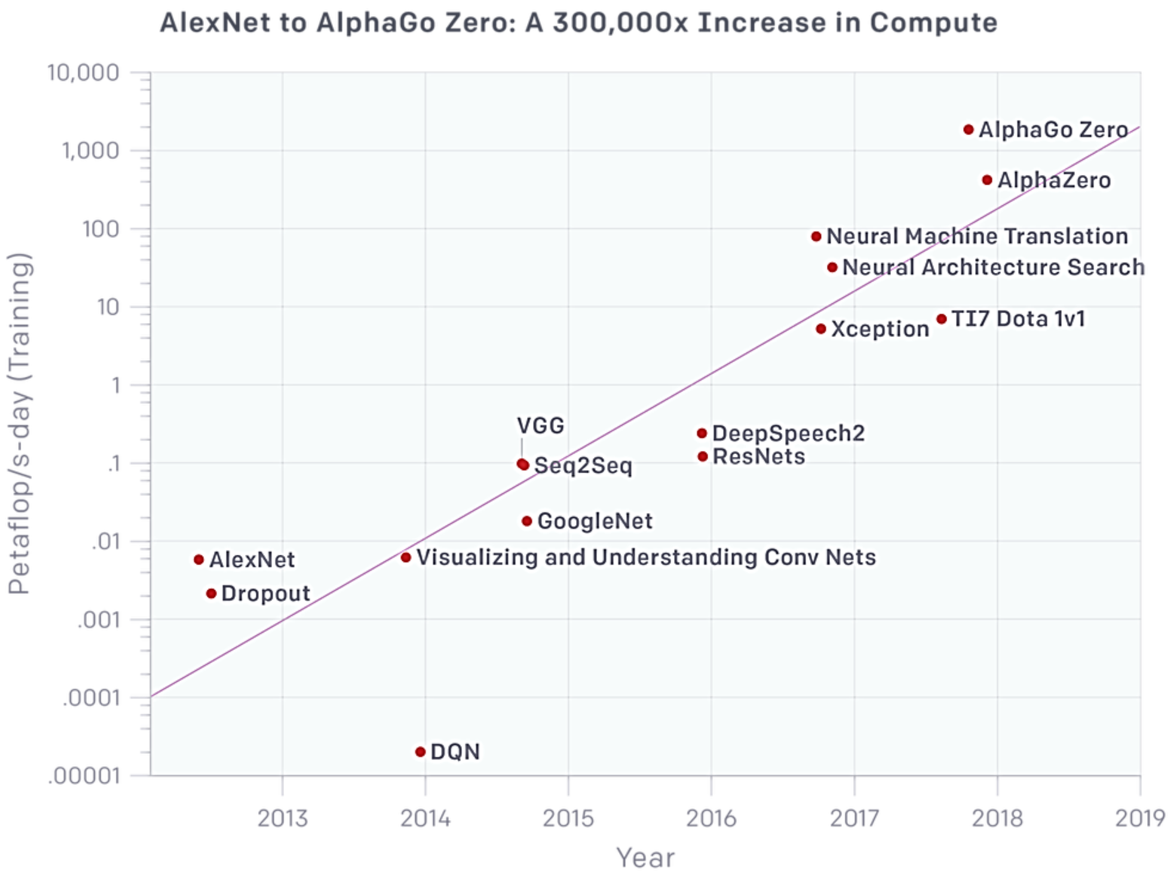
In fact, you will understand that in addition to understanding and identifying the words spoken to him/her, humans have indeed a lot of other information to understand the meaning of what is said to him/her. For example, the human will understand the **context of a conversation**, the **history of a relationship**, the **purpose**, the **emotions felt,** the **non-verbal expression of the body**, etc... In short, the *words themselves do not represent more than 20 to 30% of the message* and the rest appeals to our human nature.

And that's where the problem lies with an intelligent machine; if it can recognize words in more efficient ways than a human, it does not have **enough information** to be able to identify all the other components of the message allowing it to detect their **deeper meaning**. And even if Google Duplex made a strong impression on the media with the signs of **mutual understanding** that the robot inserted into the conversation ("Mmmhhh" at almost the right moment), that does not mean that the robot necessarily understood the real thing. meaning the mimicry of language that it was programmed to pronounce.

On the other hand, **in digital writing** (email, chat, social networks), the models start to produce a real expression of empathy with the client at the other side and can sustain a varied conversation for several minutes. This may be due to the fact that for the human being, the **written medium is much more limited** as to the range of emotions that he/she can express.

Computation capacity

Although since 2010-2011 (remember, *the second spring of artificial intelligence*) and AlexNet, we have been able to **multiply by 300,000 the computing capacity** of artificial intelligence algorithms, it seems that a new *"glass ceiling" or 'Winter'* of AI looming on the horizon.



AlexNet is one of the first algorithms of last generation. AlphaGo Zero one of the last.

Indeed, one of the latest generation algorithm models is **"AlphaGo Zero"** which was used to beat Lee Sedol, the Korean champion of the **game of Go**, a fairly simple game in principle but where the *number of possible combinations* is so important that it did not allow it to be solved by the brute force of calculation as one could do in chess. What was important at this stage was *to play a maximum of games* in a minimum amount of time to form the model in a reasonable amount of time.

The increase in computing power has therefore made it possible here to learn much faster than in the past (*and thus to find the right parameters*) and what was done previously in months is currently **done in days**. It's not less than **6 million games** that AlphaGo Zero had to fight to get a champion algorithm able to beat the best of humans.

But if machines learn faster, that does not mean that they **become much smarter**. A striking example is the difficulty that the whole world of research encounters at this moment to solve the problem of the **autonomous car**. While these driving automatisms can be learned by a 16-year-old in just a few sessions, it seems that even the best of scientists cannot yet ***"crack the code" of autonomous driving***.

Humans vs Machines

As we hope you realize at this point, the machines have made a **fantastic leap** in the last ten years in the intelligent use of computing and learning capabilities. Technically, it is today possible to imitate the "**human cognition**" and obtain real results with very high added value.

Architecture	Number of Neurons	Number of Synapses
Fly	100K = 10^5	10M = 10^7
AlexNet	650K = 10^6	60M = 10^8
Mouse	100M = 10^8	100B = 10^{11}
Human	100B = 10^{11}	100T = 10^{14}- 10^{15}

For comparison, here we show you the ability of **neurons and synapses** of a fly, AlexNet of a mouse and the human species. **100 billion neurons and 1 billiard synapses**, that is what represents the computing capacity of a human brain. Translated into current terms, it is about **10,000 CPUs on Amazon EC2**, or about *$ 1,000 / hour*, a relatively reasonable amount. And if you take one of Nvidia's latest **Graphical Processing Unit (GPU)** processors, the N100 is **10 CPUs on US university networks - just over $ 30 an hour!**

But you will understand that the ability to calculate is not everything, it is also necessary to learn the model and for this, just as for the human species, **20 to 25 years are necessary to make a good agent from birth to seat** and especially a good human being and there, even at only $30 an hour for the machine, we need to admit that the human remains still very competitive.

Feel free to share your experiences and help us improve this document either by email (info@nixxis.com) or via our forum on the website www.nixxis.com/forum.

We wish you a pleasant, successful and successful call centre future.

Some References

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