Artificial Intelligence in the development of modern infrastructures

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Abstract

Artificial intelligence (AI) makes it possible for machines to learn from experience, adjust to new inputs and perform tasks as human beings. Most of the examples of AI you hear about today - from computers playing chess to autonomous driving cars - rely heavily on deep learning and natural language processing. Using these technologies, computers can be trained to perform specific tasks by processing large amounts of data and recognizing patterns in the data. Hospitals are using predictive analytics to allocate critical resources. Government agencies are implementing social network analytics for contact tracing. Producers of food and medical supplies are forecasting new supply chain scenarios. Health officials are building epidemiology models to predict impacts on populations and infrastructure. And, in every case, AI is at the front line.

Artificial intelligence is not here to replace us. It enhances our abilities and makes us better at what we do. Because artificial intelligence algorithms learn differently than humans; they observe things differently. They can see relationships and patterns that escape us. This partnership between human and artificial intelligence offers many opportunities. It can:

- Take analytics to industries and domains where it is currently underutilized.
- Improve the performance of existing analytical technologies, such as computer vision and time series analysis.
- Break down economic barriers, including language and translation barriers
- Enhance existing skills and make us better at what we do
- Give us better insight, better understanding, better memory, and more

Artificial intelligence will have to transform all industries, but we have to understand its limits. The main limitation of artificial intelligence is that it learns from data. There is no other way in which knowledge can be incorporated. That means that any inaccuracies in the data will be reflected in the results. And any additional layers of prediction or analysis have to be added separately. Today's AI systems are trained to perform a clearly defined task. The system that plays poker cannot play solitaire or chess. The system that detects fraud can't drive a car or give you legal advice. In fact, an AI system that detects health care fraud cannot accurately detect tax or warranty claims fraud. In other words, these systems are very, very specialized. They focus on a single task and are far from humane. Likewise, self-learning systems are not autonomous systems. The imagined artificial intelligence technologies you see in movies and on television are still science fiction. But computers that can probe complex data to learn and perfect specific tasks are

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becoming quite common. AIoT is a term, also known as intelligence of things, which refers to the new wave of the future of technology that combines two major platforms, very present in today's market: Artificial Intelligence (AI) and the Internet of things (IoT).The IoT is a concept that refers to a digital interconnection of everyday objects with the Internet.

It has its theoretical basis in the addition of sensors and connectivity to any object and, eventually, it can also have its own processing capabilities, although this is not strictly necessary to enter the definition of IoT. On the other hand, Artificial Intelligence is an algorithm nurtured by statistical models that allow "learning" through feedback. What is intended to do with this union is to try to add a cognitive and executive layer to the current functionality of objects in order to provide them with autonomy to analyze situations and make decisions. As IoT devices will generate large amounts of data, Artificial Intelligence is going to be functionally necessary to deal with these huge volumes if we are to have any chance of making sense of the data. This whole process will be called connected intelligence. To take this step forward and definitively enter the era of Intelligence of Things, we will need to enable to a greater or lesser part these cognitive and executive capacities towards objects. To do this, we are going to talk more and more about the concept of Edge Computing (or "edge computing"), which is nothing more than the ability to process data, analyze situations, evaluate possible scenarios and make decisions from the object itself and not from a server hundreds or thousands of miles away. There are several manufacturers, with whom we work at Monolitic, who are incorporating this concept into their portfolio. Some examples are Espessif, Innodisk or IEI, among others. It should be noted that, after the launch of AIoT, speculation begins about the next step to follow, known as Intelligence of Everything (IoE) or, in other words, the arrival of autonomous systems. Artificial Intelligence revived in the last decade. The need for progress, the growing processing capacity and the low cost of the Cloud have facilitated the development of new, powerful algorithms.

The efficiency of these algorithms in Big Data processing, Deep Learning and Convolutional Networks is transforming the way we work and is opening new horizons. Thanks to them, we can now analyse data and obtain unimaginable solutions to today's problems. Nevertheless, our success is not entirely based on algorithms, it also comes from our ability to follow our "gut" when choosing the best combination of algorithms for an intelligent artefact. It's about approaching engineering with a lot of knowledge and tact. This involves the use of both connectionist and symbolic systems, and of having a full understanding of the algorithms used. Moreover, to address today's problems we must work with both historical and real-time data. We must fully comprehend the problem, its time evolution, as well as the relevance and implications of each piece of data, etc. It is also important to consider development time, costs and the ability to create systems that will interact with their environment, will connect with the objects that surround them and will manage the data they obtain in a reliable manner.

In this keynote, the evolution of intelligent computer systems will be examined. The need for human capital will be emphasised, as well as the need to follow one's "gut instinct" in problem-solving. We will look at the benefits of combining information and knowledge to solve complex problems and will examine how knowledge engineering facilitates the integration of different algorithms. Furthermore, we will

analyse the importance of complementary technologies such as IoT and Blockchain in the development of intelligent systems. It will be shown how tools like "Deep Intelligence" make it possible to create computer systems efficiently and effectively. "Smart" infrastructures need to incorporate all added-value resources so they can offer useful services to the society, while reducing costs, ensuring reliability and improving the quality of life of the citizens. The combination of AI with IoT and with blockchain offers a world of possibilities and opportunities.

The use of edge platforms or fog computing helps increase efficiency, reduce network latency, improve security and bring intelligence to the edge of the network; close to the sensors, users and to the medium used. This keynote will present success stories regarding biotechnology, smart cities, industry 4.0, the economy, and others. All these fields require the development of interactive, reliable and secure systems which we are capable of building thanks to current advances. Several use cases of intelligent systems will be presented and it will be analysed how the different processes have been optimized by means of tools that facilitate decision-making.

A fundamental aspect involved in applications within Industry 4.0 is the Internet of Things (IoT), which emerges as a new milestone in the Internet for that billions of objects are equipped with various types of sensors, connected to the Internet through heterogeneous networks. However, the information that is generally provided to users is based on one-dimensional space, and corresponds mainly to the location where the sensor is located. They will be presented will have related to the different open and interoperable layers that the different IoT architecture schemes, including FIWARE, ETSI or GS1 in the IoT mediation and management layers, as well as standards such as MQTT, LightWeight M2M and OneM2M in the IoT services layer.

IIoT and Edge Computing for monitoring and detecting patterns in Industry 4.0 Smart cities, precision agriculture, home automation, telemetry and smart meters, as well as the monitoring of remote industrial facilities, are just some examples of telemonitoring of the applications that the more than 26 billion connected IoT devices in the world in 2019 according to IHS Markit. Such quantity of devices generates a huge volume of data that is transferred to infrastructures in the Cloud, implying computation and storage costs in it. In this sense, there is still much to exploit the benefits of Edge Computing to reduce the necessary traffic to the Cloud and maintain operability during potential communication outages with the cloud. Machine Learning and AI Algorithms for Classification Machine Learning techniques include a wide variety of algorithms, among which we can highlight in general: neural networks (deep Neural Networks within the so-called Deep Learning), perceptrons, SVM kernels (Support Vector Machine), decision trees, Case Based Reasoning (CBR), or clustering techniques. Thanks to this type of technique, it is possible to classify a set of input data into a series of output categories. These techniques include the well-known k-means or advanced spectral clustering [1-313].

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