



Artificial Intelligence State of Art

(source: innovation community)



Technology Overview

The term Artificial Intelligence (AI) refers to the development of software, often also combined with hardware systems, capable of processing complex problems, acquiring data and supporting decision-making processes based on the evidence gathered.

AI allows the automatic processing by complex learning algorithms of huge amounts of data (Big Data) and the identification of patterns and correlations that would be difficult to detect based only on human experience. The machine, therefore, is "trained" to recognize images, interpret language, foresee risks, identify trends in order to support the human being to know and interpret reality.

AI/IV is now generating real revolutions in industry, administration and society: it can be seen as an opportunity to increase labour productivity and to enable extraordinary progress towards sustainable development.

At the same time, we must take into account that an improper use of AI/IV can generate risks related to the possibility of exclusion or discrimination of social groups, the manipulation of public opinion (as in the case of so-called deepfakes) and also for military purposes (cyberwarfare).

AI can't be defined as a technology, but rather as a family of technologies whose common denominator is the possibility to learn automatically and thus simulate as much as possible activities typical of the human being.

Depending on the type of data and the applications to be developed, three different AI systems can be divided:

1. **Supervised learning**, which consists of teaching a computer system with a range of information and experience acquired previously. In this way, when the application is faced with a problem, all it has to do is to draw on the experiences entered into its system, analyze them, and decide what response to give on the basis of experiences already codified. Classification and regression algorithms (such as *Random Forest*, *Gradient Boosting*, *Support Vector Machine*, ...) can be included among the supervised learning methods.
2. **Unsupervised learning**, which consists of providing a set of inputs to a computer system, which will then be reorganised according to common features and used to predict future scenarios. Therefore, unlike the previous case, we do not have available the already annotated inputs with which we can guide the learning of the algorithm, but the last one must be done autonomously. Among the techniques with unsupervised learning, several clustering algorithms can be identified



(*Kmeans*, *Latent Dirichelet Allocation*, ...).

3. **Reinforcement learning** is the most complex system, and requires the application to be equipped with systems and tools capable of improving one's learning and, above all, of understanding the characteristics of the surrounding environment - supporting elements, such as sensors, cameras, GPS and others, which allow one to detect what is happening in the physical or digital environment.

Artificial intelligence covers all technological areas thanks to its ability to process huge amounts of data and companies become data driven: new areas of application and new professional figures involved.

At Enel this translates into the constitution of solid data architectures, development of initiatives based on artificial intelligence models in all business lines and the establishment of a Data Scientist (Data Competence Center) group.

There is in fact an increasing demand for skills and resources such as Data Architect and Engineer, who are new figures in the IT landscape, to whom we ask to know best of breed technologies, increasingly closer to the development of end to end, cloud based platforms.

The main applications are security processes, video analysis, machine and deep learning for classification, anomaly detection, predictive maintenance and virtual assistant.

MAIN APPLICATION

GI&N: Image recognition – Application DAC (Digital Asset Capturing)

The application concerns the maintenance activities of overhead power transmission and distribution lines, managed by the I&N companies of the enel group (e-distribution in Italy, Endesa in Spain, etc.).

In particular, this project has an impact on the heliport inspection activities (by helicopter) of HV or MT overhead lines, conducted to date with the help of qualified third part companies.

The current model of activity management requires the company, during the aerial inspection along the lines, to carry out a photographic survey of the installations, characterised by defined technical specifications. In the subsequent post-processing phase of the images, the company views the photographic material in order to detect



any plant criticality and report it to the unit responsible for managing the contract and the network itself.

The Image Recognition project foresees the development of a neural network that, by processing the images acquired during a heliport inspection, automatically carries out the recognition of the network components and the critical issues that may be present. Then, once the industrialization of the solution has been carried out, the management model will provide that the third party company will only perform the photographic survey by flight along the lines to be inspected and provide us with the photographic material that will then be processed internally and automatically. This will result in a saving related to the processing activities that are currently paid to the supplier companies.

The project was launched in September 2017, as part of the bigger digitization project DigI&N Italy, through the development of a Proof of Concept (PoC). The PoC (phase 1 of the project) was successfully completed in May 2018 with the development of the DAC prototype. In particular, within the PoC, a neural network was developed for the recognition of a subset of components and types of plant criticality characterizing the reality of Italian distribution networks, and a user interface dashboard.

After the PoC, the first phase of industrialization of the solution (phase 1b) was launched in June 2018, which involves increasing the types of recognized components, developing a labeling/relabeling interface and implementing the Image Recognition engine as a service. This phase will be completed in August of this year.

The last phase (phase 2) includes the increase in the types of recognized elements and the final management interface, whose technical specification is in the advanced draft phase, waiting to be completed in Agile mode with the new developer (in analogy with what was done for PoC).

GI&N: IODA (Inbound Outbound Document Application):

IODA is a system for the automatic management of all the operational documentation of E-Distribution inbound and outbound, which will be automatically classified and easily retrievable and accessible as collected in a single system. It is a Digitally initiative, developed with an agile methodology, which involves data scientists, businesspeople, developers, ...

The documents are processed with Image Recognition and Natural Language Processing techniques before being processed with Deep Learning algorithms to allow



automatic classification. The entire project has been developed on a micro-service architecture that is easily scalable and reusable by other applications.

This project will save in 3 years about 5.3 million euros corresponding to about 72 FTE, in addition of course to ensuring better efficiency for end-to-end document management in terms of time and accuracy in classification.

GI&N: DELFI (increases quality of load profile curves through machine learning and predictive modelling):

DELF is an application to identify consumption in order to improve the quality of load curve validation, reduce computational time, manual intervention and customer complaints.

Using the Unified Virtual Data Lake (UVDL) on the C3 platform, a machine learning model has been developed to predict four-hour consumption curves one day in advance for all customers with open meters. To date, curves of about 8 million consumer customers are predicted, but soon this number will extend to 32 million. A further improvement of the model concerns its extension also to GMEs and manufacturers.