



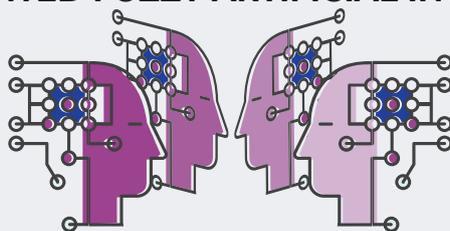
Robust & Explainable AI

for critical decisions

WWW.XTRACTIS.AI

Predictive Intelligent Robots

BY AUGMENTED FUZZY ARTIFICIAL INTELLIGENCE



- 
 An AI which explains in detail how it makes its decisions, by creating decision-making systems based on explicit rules that are understandable by the business expert.
 > **Auditable, Traceable and Certifiable AI** <

- 
 An AI which learns alone to learn better: its robots are able to infinitely improve their reasoning strategies in a competitive, then in a collaborative way.
 > **Collective and Evolving AI** <

- 
 An AI which is resistant to fuzziness, which knows how to learn even on low-quality or low-quantity data, to offer powerful predictive models in new situations.
 > **Robust and Resilient AI** <

USE-CASES / PREDICTIVE APPLICATIONS



FINANCE, INSURANCE, MARKETING
Customer behavior (palatability, attrition), risk analysis, Malicious activities...



R&D, SMART INDUSTRY
Optimal Product Design, Diagnostics, Maintenance, Quality, Data Fusion...



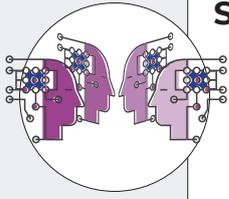
DEFENSE, SECURITY
Cybersecurity, Fraud, Crime, ADAS, Biometrics, Decision support for command and control, Object Recognition...



HEALTH, BIOTECH, PHARMA
Personalized Epigenetic Medicine, Supervision of Patients, Drug Discovery...

xtractis® Key Features

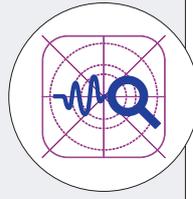
A PROPRIETARY TECHNOLOGY IN A FULLY AUTOMATED SOLUTION



SELF-LEARNING

GENERATE automatically discovers predictive models that are robust and explainable from multidimensional databases, through a collective and evolving machine learning.

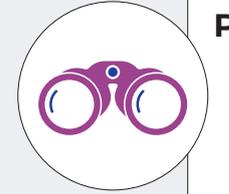
INDUCTION



AUTO-MAINTENANCE

MONITOR continuously monitors the performance of the deployed models, builds the new learning bases and requires from **GENERATE** to regenerate the expired models.

SUPERVISION



PRÉDICTIONS

PREDICT uses the models to deduce predicted responses of the process in real time.

DEDUCTION



PRESCRIPTIONS

OPTIMIZE uses the models to discover the optimal solutions that satisfy your multi-objective request.

ABDUCTION

	xtractis® GENERATE	xtractis® PREDICT	version SERVER	xtractis® OPTIMIZE	version SERVER	xtractis® MONITOR
Automatic discovery of best learning strategies to automatically build best predictive models	✓					
Automatic selection of the predictive variables, Determination of the influence of each variable	✓					
GPU / CPU Massively Parallel Calculations to manage large datasets or to launch multiple robots simultaneously	GPU/CPU	CPU				
Intensive analysis of the robustness of the generated models by different cross-validation techniques (LOO, MC, Validation/Testing)	✓					
Regression, Multiclassification or Scoring Modelling	✓					
Clustering by unsupervised learning	✓					
Visualization of the decision rules, visualization of the individual contributions of the variables for each prediction	✓	✓		✓		✓
Instant and simultaneous Predictions for several studied variables with several models	✓	✓		✓		
Real time and simultaneous Predictions for several studied variables with several models			✓			
Definition of multi-objective requests on the studied variables and constraints on the predictive variables				✓		
Simultaneous inversion of several models, Discovery of exact optimal solutions				✓	✓	
Dynamic exploration of the decision surface (2D/3D cross sections)	✓	✓		✓		
Performance monitoring of models used in production, Detection of behavioral change, Building of new learning datasets						✓
Monitoring of GENERATE Robots for the regeneration of expired models						✓
Traceability reports editing	✓	✓		✓		✓
Web Service through query by client applications running on any type of OS			✓		✓	✓
Temporary License	Single-station multi-session	Single-station single-session / Floating	Web Service	Single-station single-session / Floating	Web Service	Single-station single-session
How to use	Private SaaS / Client Site	Private SaaS / Client Site / Embedded	Private SaaS / Client Site	Private SaaS / Client Site / Embedded	Private SaaS / Client Site	Private SaaS / Client Site
Operating System	WINDOWS / WINDOWS SERVER					

10 questions for a quick overview

TO GET TO KNOW THE XTRACTIS AI

1 - WHAT EXACTLY DOES THE XTRACTIS AI DO?

Today AI is well known for imitating human perception, essentially speech and vision, and for processing natural language. But we know less that AI can also model any complex process (multidimensional, non-linear, weak signals), particularly human reasoning during a decision process, and even less that it can handle cases where the operating environment or decision environment is fuzzy (imprecise, uncertain, subjective).

It is exactly for this purpose that the xtractis AI is used: by inductive learning, it automatically discovers the rules that describe the process to be modeled. This learning is done from a dataset, compiling different reference situations of the process. xtractis uses all available data, selects the variables that explain the process, builds their fuzzy classes, generates the predictive models, and finally extensively evaluates their robustness to offer the most efficient models (see question 9).

The models built by xtractis are defined by a set of "IF...THEN" gradual rules -called fuzzy rules- that help to understand the underlying behavior of the process under study. Once these decision systems are deployed, one can predict the effects of the process or prescribe the most satisfactory solutions to optimize it.

2 - WHAT IS AN XTRACTIS MODEL?

A fuzzy "IF...THEN" rule is a local, non-linear model linking nuanced variables. Mathematically, it defines a non-linear multidimensional function linking some input variables to the output variable.

An xtractis model is defined by a set of fuzzy rules covering the operating space. Any situation/case in this space leads to the simultaneous and gradual triggering of some rules, then to the interpolation of their decisions: the local rules interact with each other and cooperate to calculate the most appropriate final decision.

The higher the number of fuzzy rules of a model and the more input variables it uses, the more it will describe the behavior of a complex process in an accurate way. The prowess of xtractis

is to find the actual level of complexity of the studied process: Its ultimate objective is always, to discover the most robust and the most compact model, i.e. the most efficient and the most explainable one (see questions 9 & 10).

3 - WHAT ARE THE SCIENTIFIC BASES OF THE XTRACTIS AI?

The xtractis AI is the result of over 15 years of R&D in Fuzzy Mathematics, Symbolic AI and Knowledge Discovery from Data (KDD) within INTELLITECH.

Fuzzy theory offers formally rigorous concepts, techniques and methods for modeling and processing, in a multidimensional way, fuzzy knowledge and fuzzy data (containing imprecision, uncertainty or subjectivity, as in real life). Formally, fuzzy theory defines a gradual interface between qualitative/symbolic and quantitative/numeric concepts. From a practical point of view, it offers a natural and efficient approach to the resolution of multidimensional and complex problems characterized by strong interactions of the components involved, where Human is both a sensor and a decision-maker or an actuator.

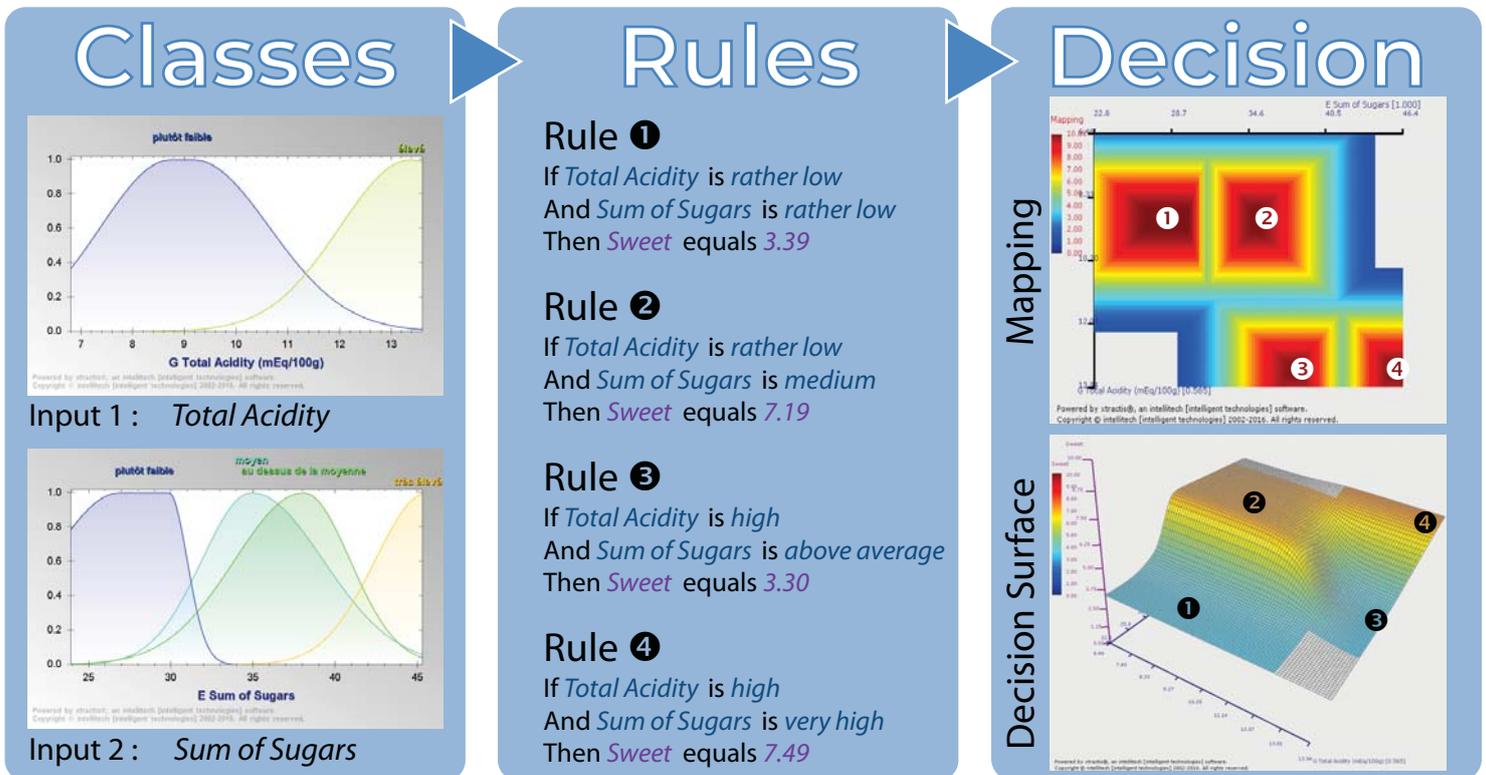
More precisely, the xtractis AI is based on the Theory of Fuzzy Relations of order N (RF-N) [Zalila 1993], coupled with Evolving and Collective Automatic Inductive Learning. The objective of xtractis is to discover RF-Ns, i.e. multidimensional and non-linear fuzzy patterns, and then transcribe them into fuzzy rules.

We invite you to read our white papers to explore the issue.

4 - WHAT PROCESSES CAN IT MODEL?

The xtractis AI was originally invented to model benevolent human behavior: sensory perception of products, consumer liking and subjective evaluation. It was then successfully used to detect malicious human behavior (fraud, security, cybersecurity).

Actually, its universal approach makes it possible to model any complex process or phenomenon including natural phenomena in science... as long as a dataset is available.



Example of a simple model for the Sweet Perception of a fresh tomato: 2 variables, 4 fuzzy rules



5 - WHAT DATA CAN IT USE?

The xtractis AI can process data of various kinds: quantitative or qualitative data, hedonic evaluations, preferences, expert opinions, sensory or instrumental measurements, signals, images, socio-economic data, formulations, product characteristics, genetic sequences...

If xtractis can currently manage structured text data, future R&D actions will also allow it to process text mining.

The effect to be predicted may be a numerical variable (regression), one or more classes to which a new profile would belong (multiclassification), a risk of occurrence of an event (scoring), or the detection of stable clusters on the data by unsupervised learning (clustering).

The quality of the models depends on the quality of the data. However, xtractis can handle missing data (see question 8), noisy data and / or in small quantities. A robust xtractis model (see question 9) can also be used to detect and filter noise in the data set. It should be noted that if the reference database did not contain enough exploitable information, xtractis would be unable to discover a robust model.

6 - WHY IS IT SO POWERFUL?

Benefitting from the advantages of the RF-N Theory, the xtractis AI is particularly efficient in a complex environment in which the three aspects of fuzziness coexist (imprecision, uncertainty and subjectivity). And this is usually the case of real-world processes that we are trying to model.

xtractis robots deploy an infinite family of inductive learning strategies to provide robust models, i.e. models that guarantee the reliability of their predictions in situations that have not been part of the learning phase. Therefore, the xtractis AI avoids overfitting or overlearning.

In addition, these robots automatically and collectively improve their reasoning strategies to continuously improve the robustness of the discovered models, even if the database does not change: they learn to learn better.

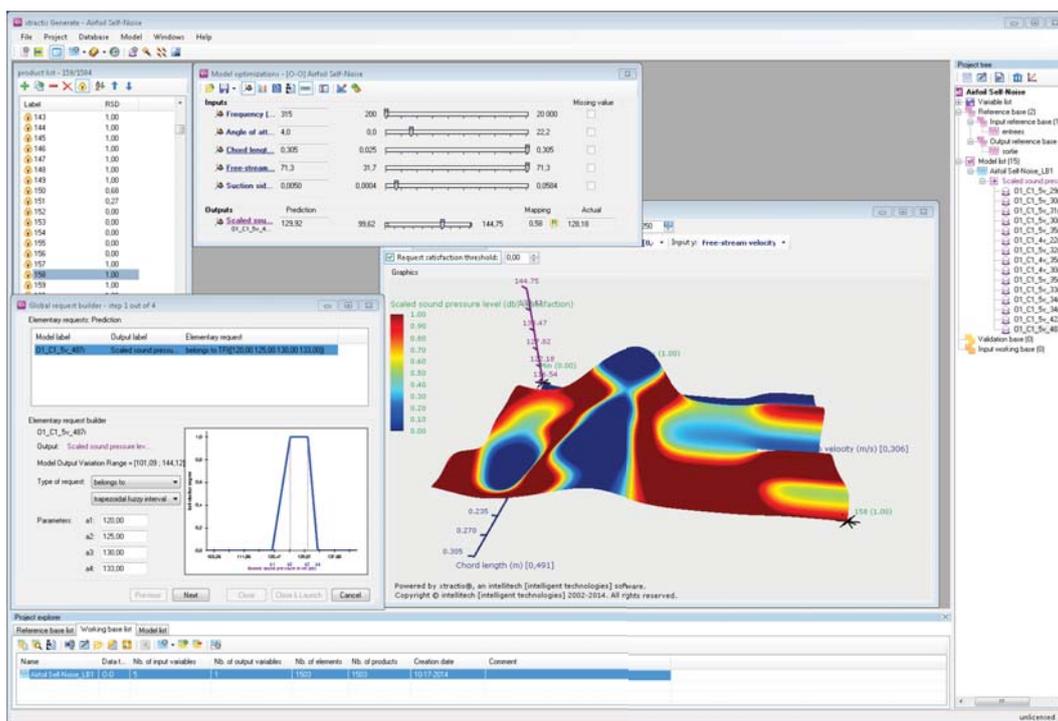
The xtractis AI has won many benchmarks against other open source techniques, whether statistical or AI-based: Polynomial Regression, Logistic Regression, PLS, CART Decision Tree, Random Forest, Boosted Trees, Kernel Support Vector Machine, Deep Learning / Neural Networks... Of course, INTELLITECH's team has an expert knowledge of all these techniques to be able to highlight their advantages and their limits.

7 - WHAT CONTRIBUTIONS TO BUSINESS PROCESSES?

The xtractis AI makes it possible to quickly and systematically develop predictable and efficient decision-making systems. Deploying such systems brings great value to business processes:

- Understand and improve the decision process.
- Perpetuate the Business Knowledge assets of companies and organizations.
- Anticipate a process effects in response to unknown situations.
- Discover optimal prescriptions for complex processes.
- Identify and analyze risks in a critical process.
- Quickly design new products and find new formulations.
- Optimize existing products or formulations to increase their efficiency, their liking or reduce their manufacturing cost.
- Automate decision-making in order to gain productivity or impartiality, while clarifying the system's rules, in order to ensure regulatory compliance of the decision-making system.
- Audit a "black box" model and turn it into a certifiable rule-based model.
- Redesign an "old" decision-making system that has become difficult to maintain (Reverse Engineering).

Applications are multi-sectoral and transversal: Smart Industry, Transportation, Defense, Security, Nuclear, Finance, Risk Analysis, Healthcare, Law, Politics, Marketing & CRM...



Screenshot xtractis OPTIMIZE: Optimal Prescriptions



8 - AND COMPARED TO DEEP LEARNING?

One thing in common: both technologies use Machine Learning algorithms.

But there are several major differences:

- Deep Learning produces neural networks that are "black box" models, while the xtractis AI produces "white box" decision systems based on fuzzy rules, understandable by the business expert.

- A neural network is a global model: any modification of parameters changes the behavior of the decision-making system; while the xtractis model is composed of local sub-models (fuzzy rules): the modification of the premise (IF... part) or of the conclusion (THEN... part) of a rule has an impact only in the local control area of the rule. xtractis can thus improve the global model locally in order to gain efficiency while preserving the explainability.

- Unlike a neural network, it is easy to demonstrate that the output of a fuzzy rule-based system will vary continuously and gradually between a lower bound and an upper bound at any point in the decision space. The stability of such a system is thus proven, especially for critical decisions, which allows its certification.

- To learn, Deep Learning requires a very large amount of data, while the xtractis AI can handle small datasets.

- Deep Learning, like any statistical approach, handles missing data by imputation (assignment of an estimated value), which introduces a bias in the data before processing; while the xtractis AI preserves this state of ignorance (lack of information) by supposing that all the values of the unspecified variable are possible (extremal level of fuzziness).

- Deep learning algorithms are usually fixed by the modeler, while the xtractis AI is able to improve its own inductive learning strategies to enhance its performance continuously.

- Deep Learning uses the unique operators of binary logic, tensoral calculus and probability measure, while the xtractis AI uses an infinite number of multivalent logical operators, an infinite number of compositional operators by relational anchoring and an infinite number of generalized measures of possibility and necessity, which give it greater degrees of freedom in non-linear modeling.

- The algorithms of Deep Learning are open source, while those of xtractis are proprietary.

9 - WHY IS ROBUSTNESS NECESSARY?

The quality of a model is evaluated by two criteria:

i- Descriptive Capacity (DC): its ability to describe well the reference situations that led to its creation;

ii- Robustness or Generalization Capacity: its ability to predict well on unknown situations, which have not been part of its learning dataset.

Although necessary, a high DC is not enough, because it does not guarantee that the model is robust: by overlearning, the model would have a very high DC, but would often make wrong decisions in case of unknown situations.

Estimating the robustness by cross validation techniques requires an incompressible computation time of 50 to 10,000 times than it is required to create the model: it is therefore impossible to produce robust predictive modeling in real time. However, in production, predictions derived from a robust model can be provided in real time.

10 - WHY IS EXPLAINABILITY NECESSARY?

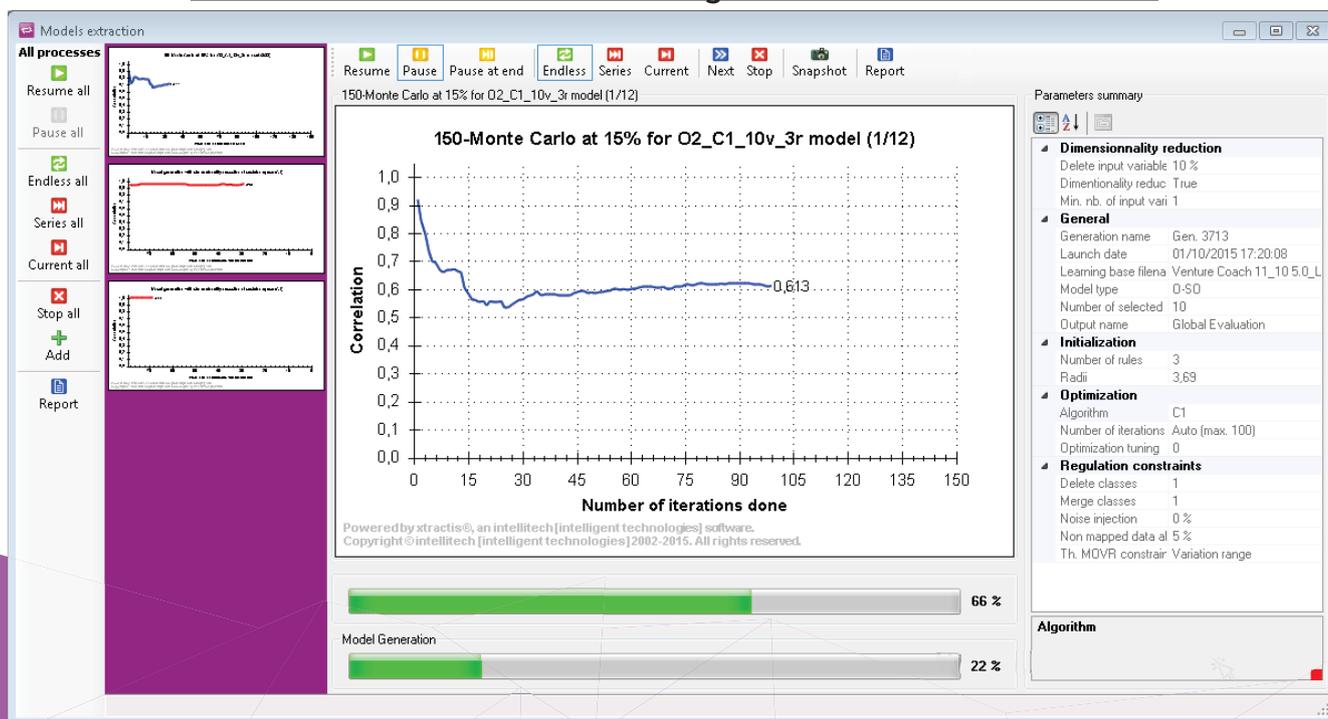
The decision system created by an AI must be explainable in all areas with high societal impact: Smart Industry, Transportation, Defense, Security, Nuclear, Finance, Health, Law, Politics. Indeed, such systems must be audited and certified by the regulator before their deployment.

However, a "black box" system could be used for Marketing or CRM applications such as product or service recommendation.

For example, a French bank could use neural networks to create chatbots, but will have to rely on explainable modeling (analytic regression, rule based-system, decision tree) to model the behavior of its clients or to evaluate the score of a credit file. The first model will be audited by the Marketing Department, while the second one will be audited and certified by the ACPR and the ECB.

In fact, since the entry into force of the European General Data Protection Regulation (GDPR), the "right to explanation" granted to any natural or legal person, undergoing an automated decision imposes on any designer of such an automated decision-making system to justify the rules that produced the decision. This prohibits de facto any "black box" decision system.

Screenshot xtractis GENERATE: Convergence of the robustness estimator



About INTELLITECH

ARTIFICIAL INTELLIGENCE INVENTORS & DESIGNERS SINCE 1998



OUR SERVICES

- ✓ Software Solutions (secure private SaaS / on-site / embedded)
- ✓ Creating predictive models from data
- ✓ Integrating xtractis models into business processes
- ✓ Supervision & Maintenance of models
- ✓ Support to the deployment of xtractis solutions
- ✓ Training and coaching targeted on the xtractis AI

SUCCESS STORIES



FINANCE, INSURANCE, MARKETING
xtractis succeeds in proposing predictive models of credit default with a Gini of 14 points higher than statistical models of logistic regression. That means much less capital to immobilize with a better detection of the most risky files.



R&D, SMART INDUSTRY

Since 2009, xtractis has discovered the optimal formulations of hygiene papers from several major international brands, adapting them to the sensory perception of consumers in each national market.



DEFENSE, SECURITY

xtractis is the winner of the TECH-CHALLENGE "Detection of objects" organized by the French General Direction of Armaments (DGA) and the French Military Intelligence (DRM) putting in competition more than 50 academic structures, blue chip companies, and SMEs specializing in AI and image processing.



HEALTH, BIOTECH, PHARMA

xtractis is able to diagnose nearly 98% of breast cancers from mammary image analysis, exceeding the performance of pathologists.

OUR CORE BUSINESS

R & D in the Theory of Fuzzy Relations of order N and Inductive Learning, to design a robust and explainable AI dedicated to strategic and critical processes.

OUR VISION OF AI

Intelligent robots that work together, self-evaluate and learn to learn better by perfecting their reasoning strategies.

"INTELLITECH develops innovative solutions based on non-standard mathematics, the basis of a sovereign and unique AI, with multisectoral applications.

We offer our clients cutting-edge AI technology to reinforce their critical and strategic decision-making processes in the most reliable and transparent possible way"

*Prof. Zyed ZALILA
FOUNDER & CEO*



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