

WE GIVE INTELLIGENCE TO MACHINES



# WE GIVE INTELLIGENCE TO MACHINES

## intelligence

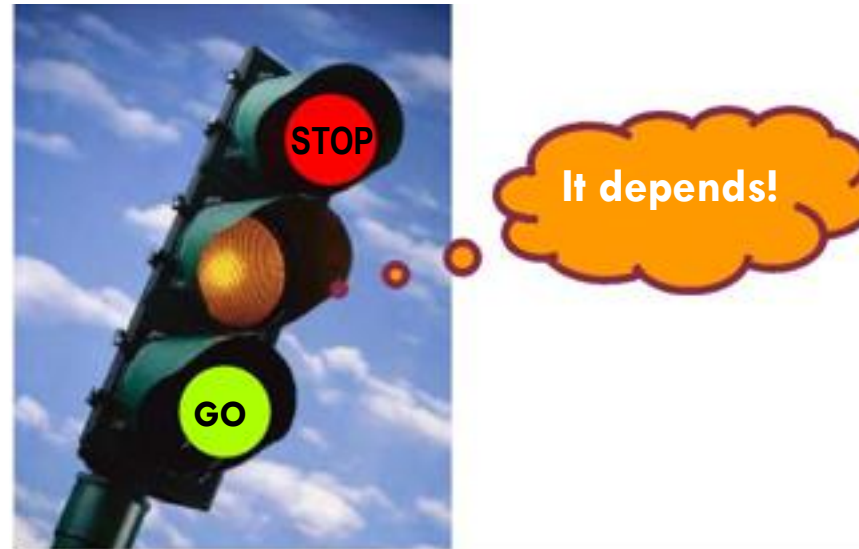
In 'tɛlɪdʒ(ə)ns/

*noun*

the ability to acquire and apply knowledge

# BRAIN-LIKE MACHINE LEARNING = NEURAL NETWORKS

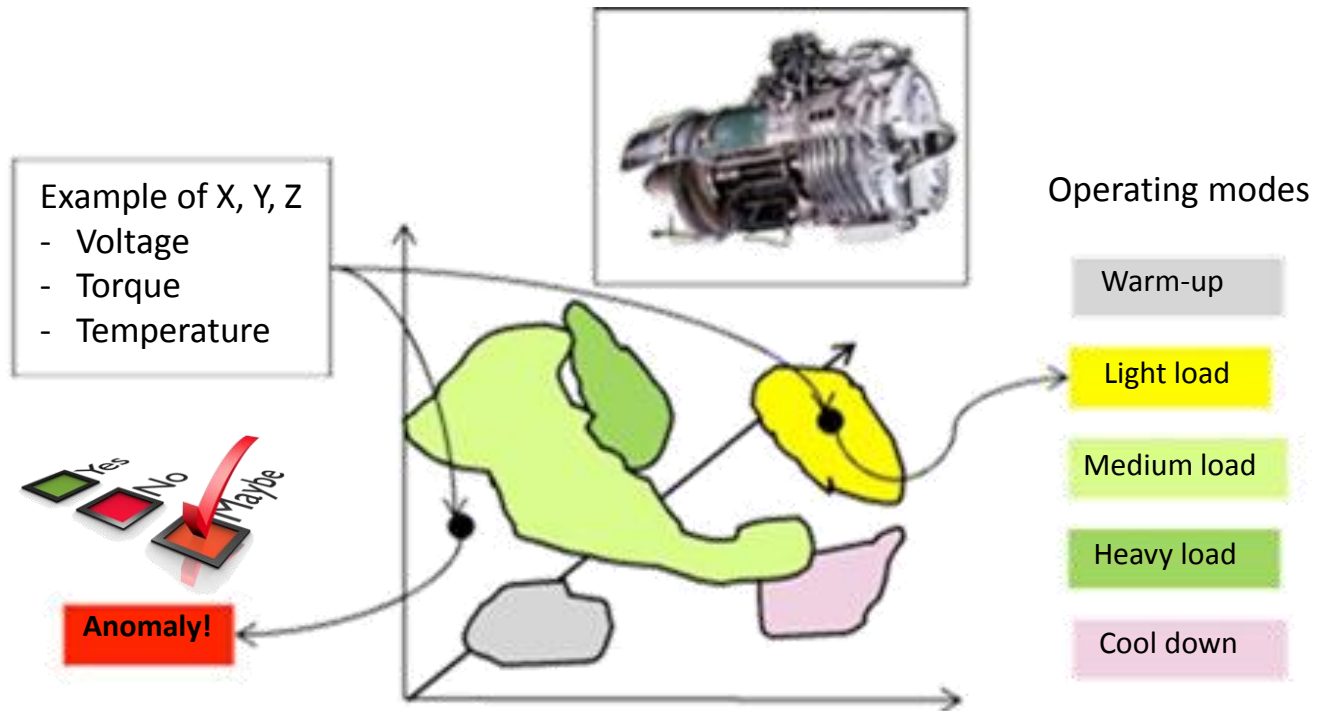
NEURAL NETWORKS CAN MODEL NON-LINEAR DECISION SPACES AND ADDRESS ILL-DEFINED PROBLEMS



An autonomous vehicle will have to adapt:  
What is my speed?  
What is in front of me and behind me?  
What are the road conditions?

# REAL LIFE IS COMPLEX: LEARN BY EXAMPLE

Neural Networks enable modelling by machine learning of non-linear decision spaces



# REAL LIFE IS COMPLEX: LEARN BY EXAMPLE

## Cogito Instruments solution relies on an Adaptive Model Generator



### Learn by examples (supervised or unsupervised)

Learning by example is more practical than enumerating rules and equations



### Map decision spaces by aggregates, not hyperplanes

Cope with non-linear, convex, disjoints and embedded categories.

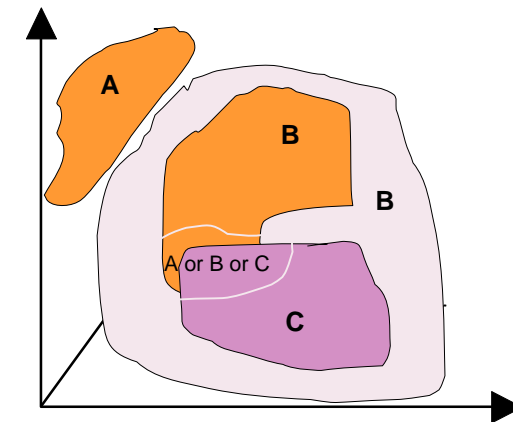
Modulations between conservative and liberal decisions with zones of uncertainties



### Save and restore the contents of neurons

Can append more training at any time – never stop learning

Learning = Building a  
**“decision space”**  
by teaching examples

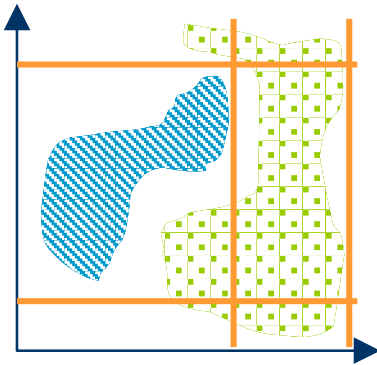




# How to model a decision space automatically?

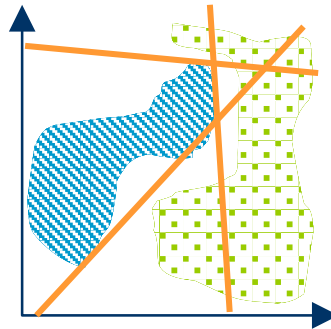
1960: Threshold method

Too simple and not non-linear



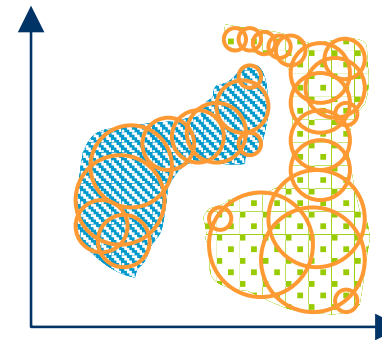
1980: Perceptron method

Too complex,  
and time consuming

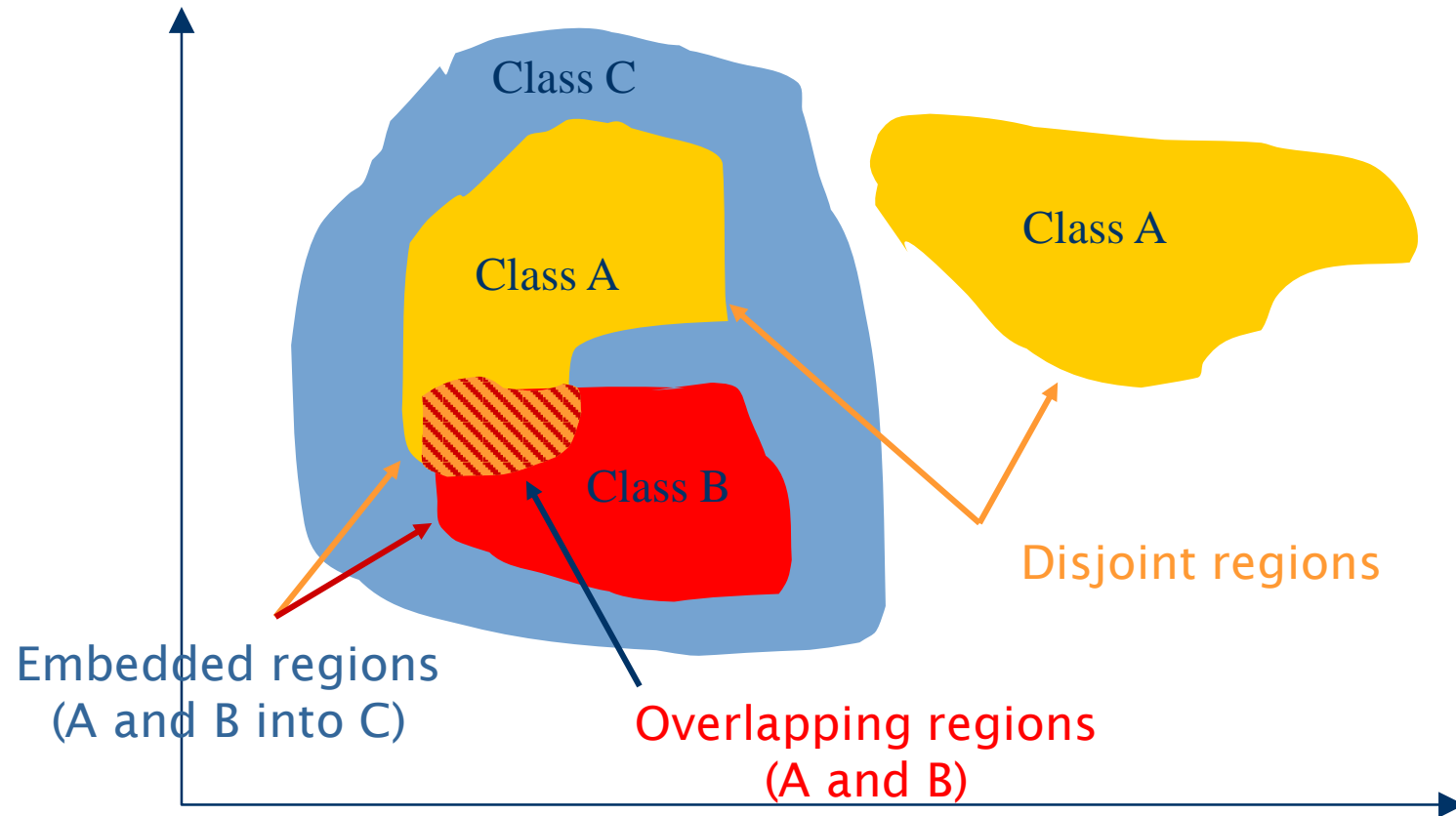


1990: RBF

Map spaces of any shape  
with the relevant training set



# Peculiarities addressed by the RBF model



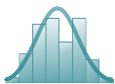
# REAL LIFE IS COMPLEX: OPTIMAL DECISION

Cogito Instruments solution relies on an High Performance Classifier



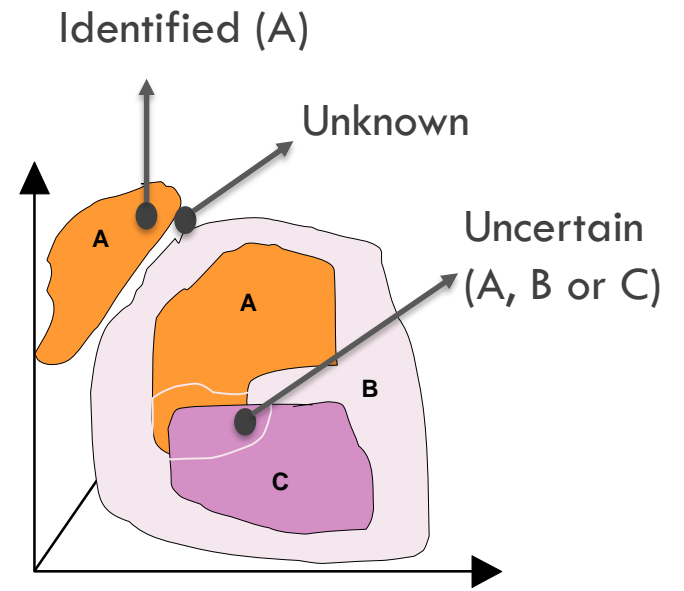
## Global response readout

- positively identified
- identified with uncertainty
- unknown



## Detailed response of all the firing neurons

- category and confidence level (or distance)
- retrieved per decreasing confidence

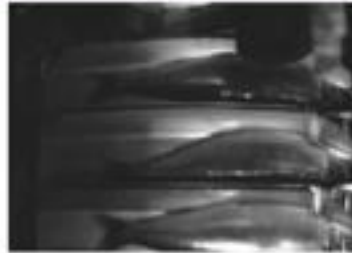




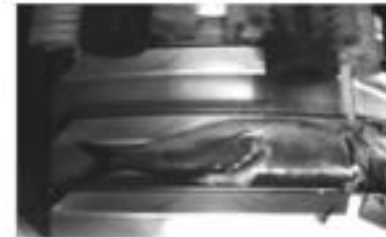
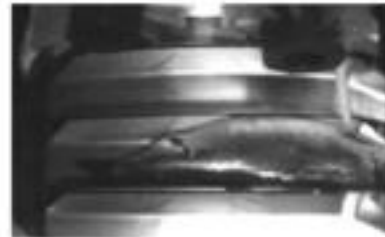
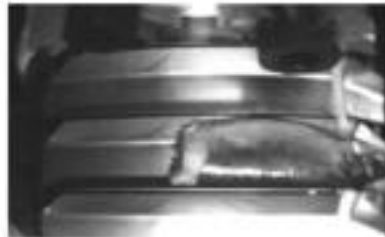
# LEARNING BY EXAMPLES

- MORE PRACTICAL THAN ENUMERATING RULES AND EQUATIONS
- THE DOMAIN EXPERT CAN TEACH THE MACHINE
- ONE EXAMPLE CAN CONTAIN MULTIPLE EXPLANATIONS

Why are these fishes acceptable?



But not these ones...

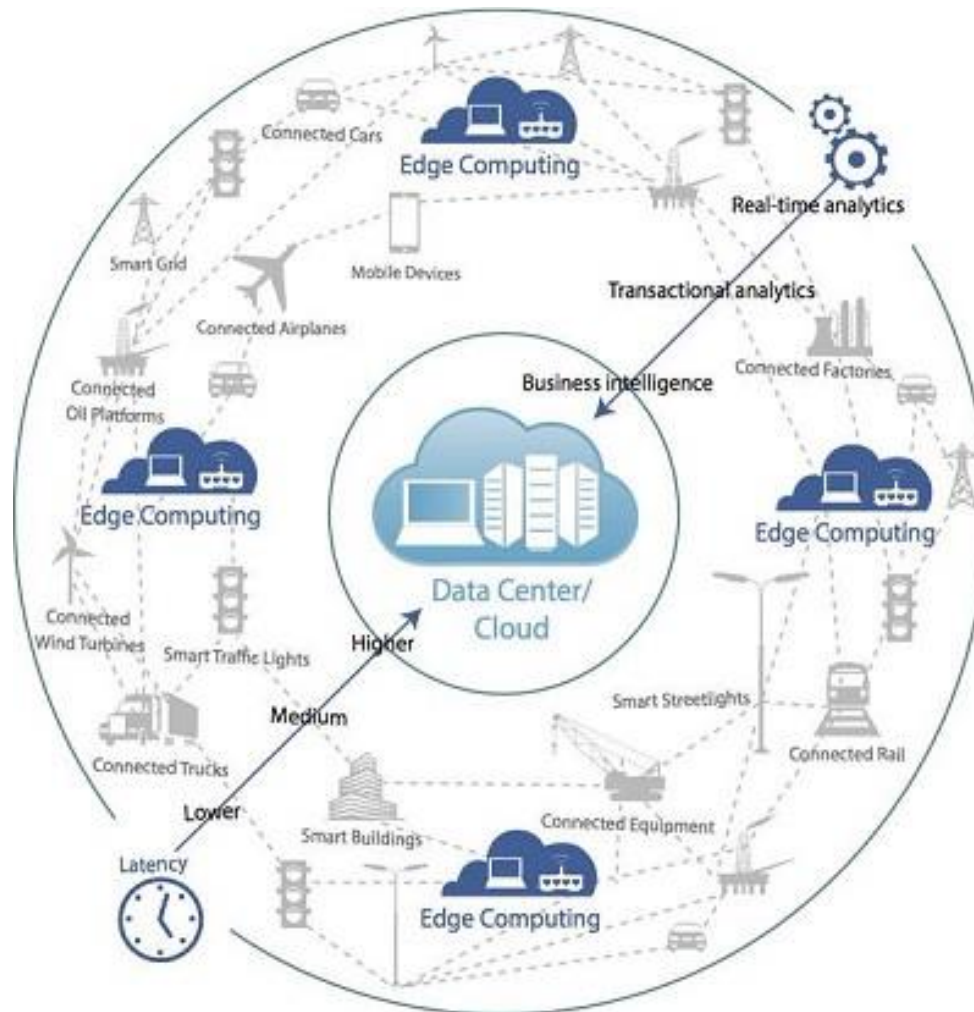


# APPLICATION EXAMPLE : GLASS INSPECTION



- High quality monochrome video sensor (725x480 pixels)
- Neural network with automatic model generator (learning by example) and high-speed non-linear classifier
- The knowledge built by the neurons can be saved and exported to other sensors, and later expanded with more teaching
- Adapts well to lighting fluctuation if taught so by showing examples taken under different conditions
- Detects anomalies as small as 2x2 pixels.
- Number of sensors : up to 50
- Material displacement : 9.53 mm/video frame
- Maximum supported velocity : 411 mm/s

# DATA ANALYTICS WON'T BE DONE 100% IN THE CLOUD



LATENCY

NETWORK BANDWIDTH

COST

SECURITY

CONFIDENTIALITY

# TWO MAIN APPROACHES TO NEURAL NETWORKS

## Software running on traditional computers – Deep Learning

**Pros:** Anyone with a PC can start “playing”  
“Potentially” covers a very wide range of applications  
(if you can afford the hardware, the bandwidth and the latency)

**Cons:** Very demanding on hardware resources. Expensive in real life  
Sequential by nature and therefore slow, energy consuming  
Learning is a lengthy offline process

# TWO MAIN APPROACHES TO NEURAL NETWORKS

## Cogito's neuromorphic hardware approach

**Pros:** Parallel by nature and therefore fast and constant latency  
Real time learning “on the job”  
Affordable, Compact, Low Power and therefore can be integrated right next to the sensors  
Able to say “I don’t know” or to give more than one answer  
Data stays local. Safe and Secure. No reliance on the Cloud

**Cons:** Potentially covers a narrower range of applications

# COGITO'S DIFFERENTIATING BENEFITS



## Fast Deterministic response time

Latency does not increase with the scaling up of the neural network, even for complex multi-dimensional classification.



## Real-time learning

Knowledge can be updated “on the job”. No need for off-line recompilation



## Knowledge and Decision embedded in the machine

Compact, Fast, Low-Power (better reliability and easier integration)



## Better than Humans

Fast upload/download enabling knowledge proliferation



## Secure and Reliable

Precious data stays local, ensuring its privacy

Results are reliable, reproducible and traceable



## Total Cost of Ownership

NI platform+Cogito solution offers much lower TCO compared to Industrial PC with GPU accelerators running software neural networks or compared to Cloud based solutions

# COGITO FIRST PRODUCT : COMPACTRIO CARTRIDGE



## Embedded Cognitive Computing

Autonomous Neural network based on neuromorphic hardware

## Multidimensional Non-Linear Data Analytics



“Learn”: An adaptive model generator

“Think”: A high performance classifier

- Radial Basis Function (RBF)
- K-Nearest Neighbor (KNN)

“Teach”: Knowledge proliferation (SD card I/F)



## Available For Best-In-Class Platform

Designed for NI's CompactRIO chassis and for LabVIEW environment

Quality and reliability in line with National Instruments standards



## Scalable thanks to extension cartridges

Fully transparent to the user - Additional neurons do not impact performance

COGITO  
INSTRUMENTS





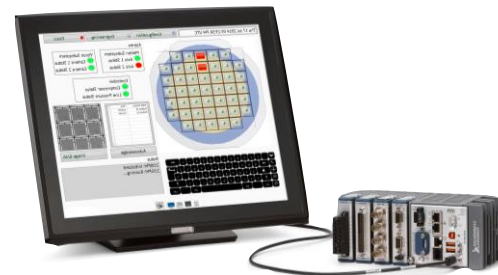
# TYPICAL APPLICATIONS

Cogito Instruments product are particularly well suited to **inspection, production testing, monitoring, predictive maintenance and robotics applications.**



Multiple Sensors  
up to 256 per CI cartridge

- Vision
- Vibration/Sound
- Temperature
- Inertial (accelerometer, gyro)
- Voltage/Current
- ...



Data Acquisition  
Feature Extraction  
Using NI platform  
and LabVIEW FPGA



COGITO  
INSTRUMENTS

Cogito Instruments  
Embedded Analytics  
Pattern Learning  
Pattern Recognition



**Classified results eg.**

Defect Categories in the  
case of testing or  
inspection

Warning categories in  
the case of monitoring or  
predictive maintenance

Actions in the case of  
robotics

# VALUE CHAIN POSITIONING

Cogito Instruments is providing subsystems to system integrators starting with National Instruments Alliance Partners



>950 National Instruments  
Alliance Partners



>35000 National Instruments  
Customers

	IC/Component Supplier	Subsystem Provider	System Integrator	End Customer OEM
Value per system	\$100	\$10,000	\$100,000	>\$1,000,000
Volumes	Millions	10's of Thousands	Hundreds to Thousands	Few factories
Companies	ST, NXP, Intel...	NI, Cogito, Beckhoff,...	Loccioni, SCI,...	VW, Airbus, ...

# COGITO IS FULLY COMMITTED TO THE NI ECOSYSTEM

**Cogito was present at NI Week 2017 in Austin**

**Cogito will present at the following events:**

- NI Day Switzerland : on September 27th 2017 in Bern
- NI VIP Days Germany : on October 18th and 19th 2017 in Munich
- NI Day France : on November 7th 2017 in Paris
- NI Day Italy: on November 14th 2017 in Milano
- NI Day UK : on November 28th 2017 in London
- SPS/IPC/Drives Exhibition : on November 28th and 29th 2017 in Nürnberg, Germany (Cogito will be on NI's booth)

# CONCLUSION

## The right technology

We have a truly disruptive approach which brings tremendous measurable benefits

We are building long term differentiation with innovative, patentable IP

## At the right time

We serve a very real, urgent and sizable need

We have already introduced our first products and clients are developing

## In the right place

Switzerland is perfectly located

# CONTACTS

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Thank you!