ALMAWAVE

Artificial Intelligence: The impacts on business, Technologies and Use Cases

Raniero Romagnoli
Antonio Cerqua

08.09.2022

Agenda

- About us
- Big Data & AI: Why Now
- Big Data: Technology & Use Case
- AI: Technology & Use Case
- Ethical AI & Moral Machine
- Almawave: Success Case & Demo
- Q&A

Who am I?

Raniero Romagnoli

Chief Technology Officer Almawave

Vice President PerVoice

Chief Executive Officer OBDA Systems

Degree in Computer Science @La Sapienza, Rome with research in Neural Networks for Computer Vision @Sydney University, Sydney, AU

20+ years in the industry

Joined Almawave in 2011

Previously in Atos Origin, Hewlett Packard, RSA (EMC)

Working in and passionate of Artificial Intelligence

Who am I?

Cerqua Antonio

Technology Consulting Director Almawave

Degree in Telecommunication Engineer @Parthenope, Naples

10+ years in the industry

Joined Almawave in 2022

Previously in AlmavivA

Passionate about computer science and the latest technologies (AI, IoT, Blockchain)

Big Data & AI: Why now?

Computing power	ML, deep learning algorithms	Big data	Age of the customer/digital demand	Huge investments

Source: “Artificial Intelligence Can Finally Unleash Your Business Applications' Creativity” Forrester report

Big Data & AI: Why now?
Computing Power

iPhone 13 Pro

- *CPU:* Hexa-core (6x3.22 GHz)
- *GPU: 5-core graphics*
- RAM: 6GB

Apollo Guidance Computer

- *CPU: 0.043MHz clock speed*
- *RAM: 64Kbyte of memory*

Big Data & AI: Why now?
Data availability

Every second

- Youtube: ~ 95.000 video views
- Google: ~ 100.000 searches
- Instagram: ~ 1.100 photos
- Twitter: ~ 10.000 tweet
- Email: ~ 3.100.000 email
- Internet traffic: ~ 150 TB
- Skype calls: ~ 6.800 calls

- Google: 130.000 Bil. pages indexed
- Web sites: ~ 1,17 Billions

But also …

- ~ 1.800 millions MWh/year
- ~ 1.600 millions T of CO2/year

https://www.internetlivestats.com

Big Data
Definition & Mission

Big data refers to data sets that are **too large or complex** to be dealt with by traditional data-processing application software.

Big data analysis **challenges** include capturing data, data storage, data analysis (expecially with Artificial Intelligence), search, sharing, transfer, visualization, querying, updating, information privacy, and data source

Big Data
5v Features

The five Vs of big data

Big data is a collection of data from various sources, often characterized by what's become known as the 3Vs: *volume, variety and velocity*. Over time, other Vs have been added to descriptions of big data:

VOLUME	VARIETY	VELOCITY	VERACITY	VALUE
The amount of data from myriad sources.	The types of data: structured, semi-structured, unstructured.	The speed at which big data is generated.	The degree to which big data can be trusted.	The business value of the data collected.



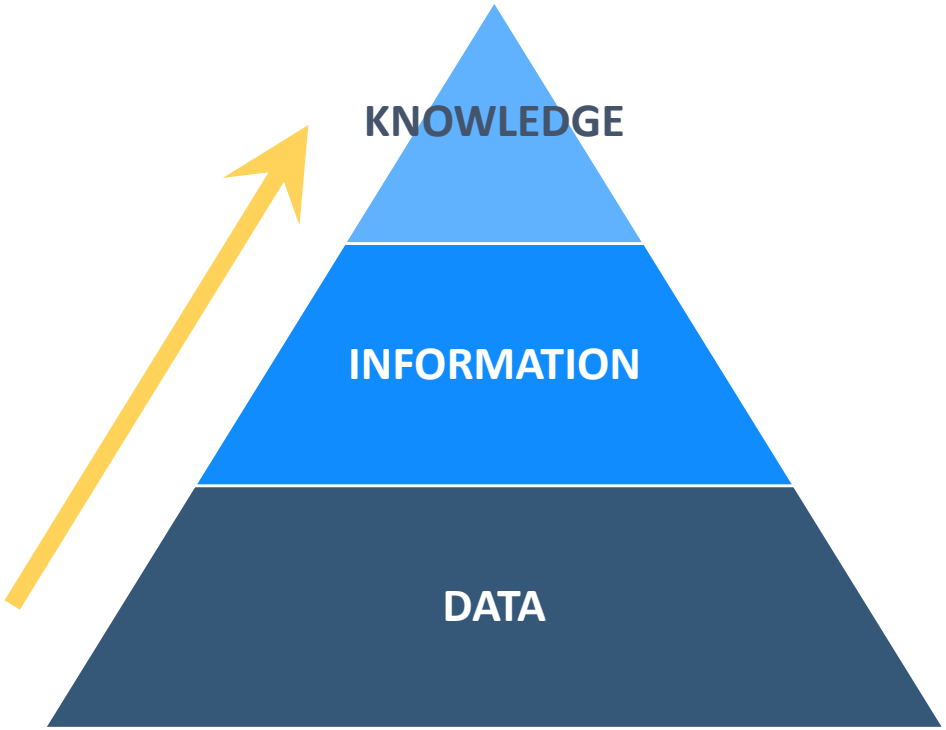


Big Data
Definition & Mission

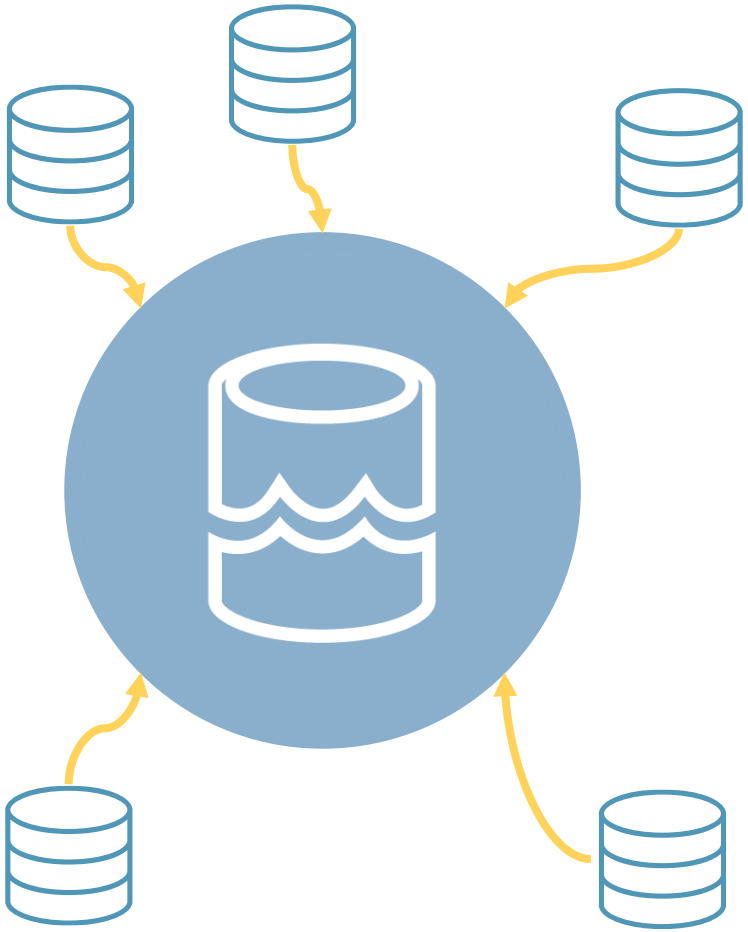
From raw data to knowledge

The extraction of value from data is a fundamental process in the era of Big Data and is characterized by the following elements:

- **THE DATA**: it is the original and elementary representation of a phenomenon
- **INFORMATION**: it is the result of the elaboration, or analysis, of the data and the interpretation of them. The information therefore represents the processed data.
- **KNOWLEDGE**: it is the awareness and full understanding of information, necessary to make the right decisions



Big Data
Definition & Mission



Single Data Repository

Collects and centrally manages data from various corporate or external sources, for...

- enable a 360° integrated view of the entire information assets
- enable the development of advanced cross-domain analytics by overcoming the silos logic
- facilitate collaboration in data analysis and decision-making processes
- allow easy identification of data conflicts

Big Data
Technology & Challenge

Technology

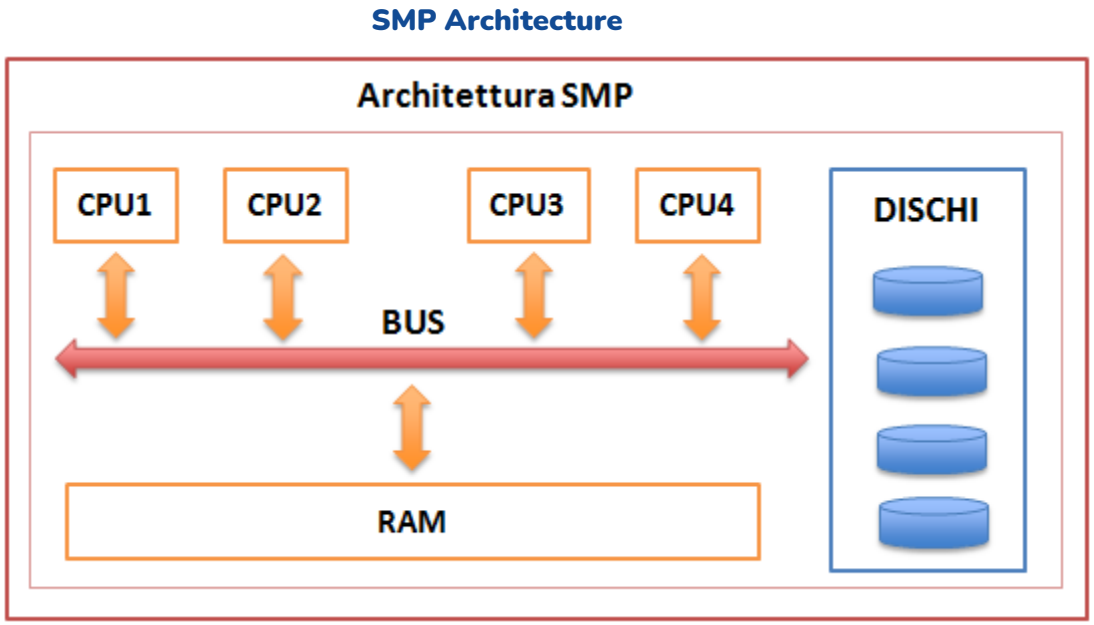
After defining what big data is, it becomes necessary to deepen the technologies in use.

The characteristics of big data, highlight the limits of traditional architectures, generating the development of technologies capable of supporting the high volume, variety and speed that characterize big data

Challenge (for IT team)

- Define new architecture (no unique)
- Improve performance
- Improve the cost / performance ratio

Big Data Technology
SMP vs MPP



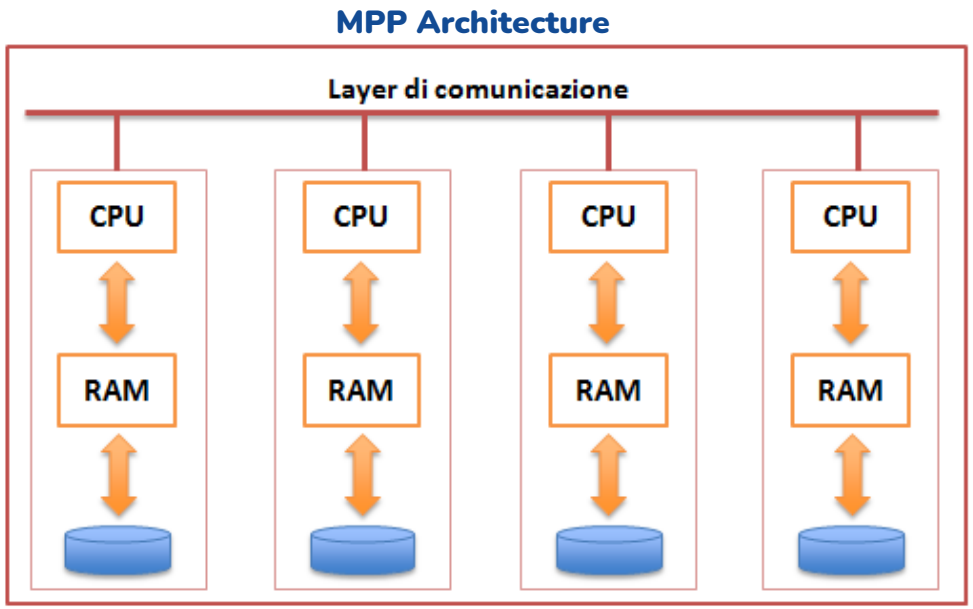
SMP

An SMP (symmetric multi-processing) system is composed of **several processors** that share the **same OS**, the **same RAM memory** and the **same Input / Output bus** - the connection channel between the processor and external devices that allows the passage of data..

RDBMSs are generally hosted on systems SMP type, these systems are efficient in applications OLTP (many updates and writes)

The main **problem** with SMP systems is the **physical limitations of memory and bus speeds**. For this reason, they are not suitable for processing large amounts of data, since there is a BUS overload

Big Data Technology
SMP vs MPP

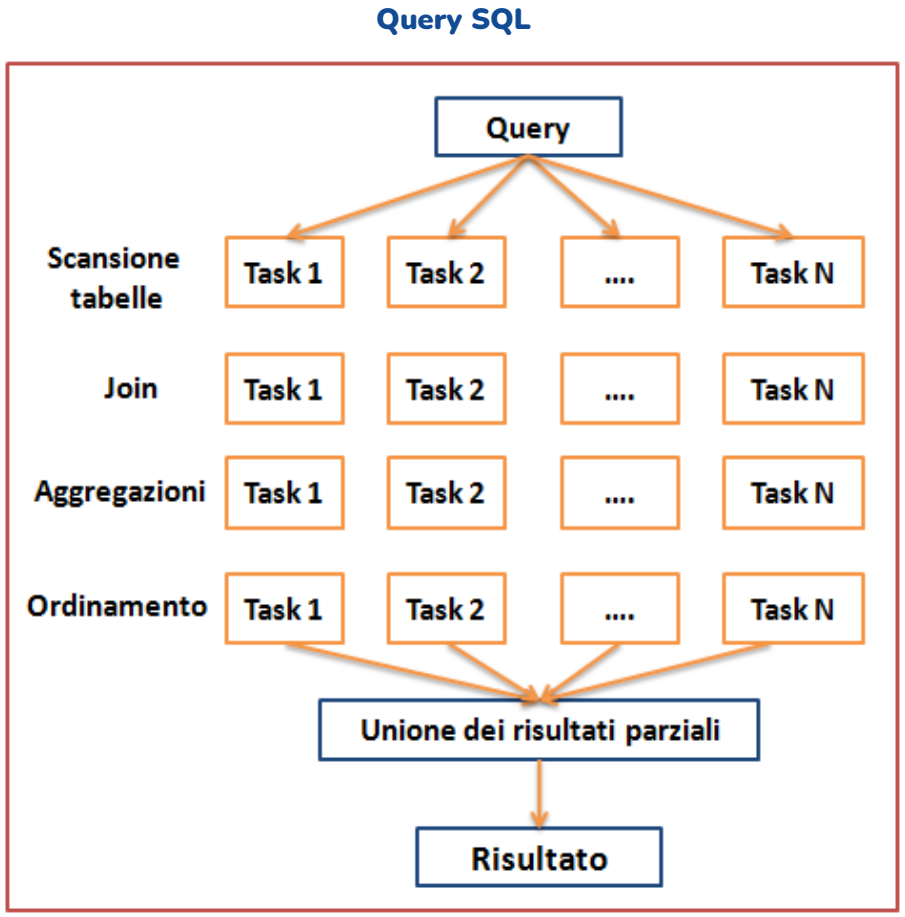


MPP

When the **data volume increases considerably,** Massive Parallel Processing (MPP) systems are better for data processing because:

- Each processor has a **dedicated I / O system and RAM**.
- **Operations** to be performed **are divided into parallel and independent tasks**.
- **Processors communicate with each other through a messaging interface** (eliminated the limits related to bus sharing).

Big Data Technology
SMP vs MPP



The SQL query is **split into a series of operations** that are performed in parallel.

Each operation is in turn broken down into **N tasks**, in order to take advantage of the parallel architecture

MPP systems are an ideal tool for dealing Big Data **Volumes**.

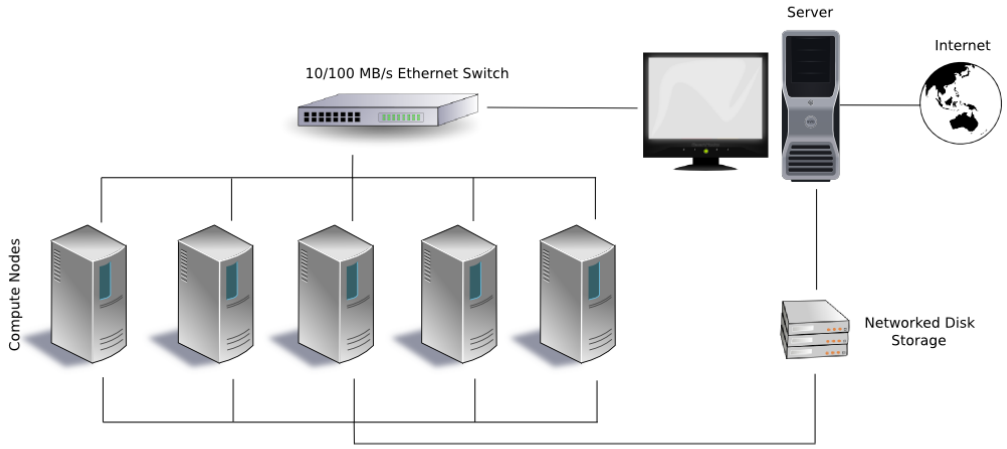
Big Data Technology
Cluster

A computer cluster is a set of computers that work together ,they can be **viewed as** a **single system**.

- The components of a cluster are usually **connected to each other through fast local area network,**
- Each node running an operating system.
- Clusters are usually deployed to improve performance (speed) and availability.

BENEFIT

- **Fault tolerance:** the ability for a system to continue working with a malfunctioning node)
- **Scalability**: the ability to add nodes horizontally. This means that more computers may be added to the cluster, to improve its performance, redundancy and fault tolerance



Big Data Technology
Hadoop & NoSQL DB

To process a very large set of data it is important to optimize the workload, for example by adopting a distributed architecture.

The main technologies currently in use are

- Hadoop (with HDFS and MapReduce / Spark components).
- NoSQL DB sharding and replication mechanisms.

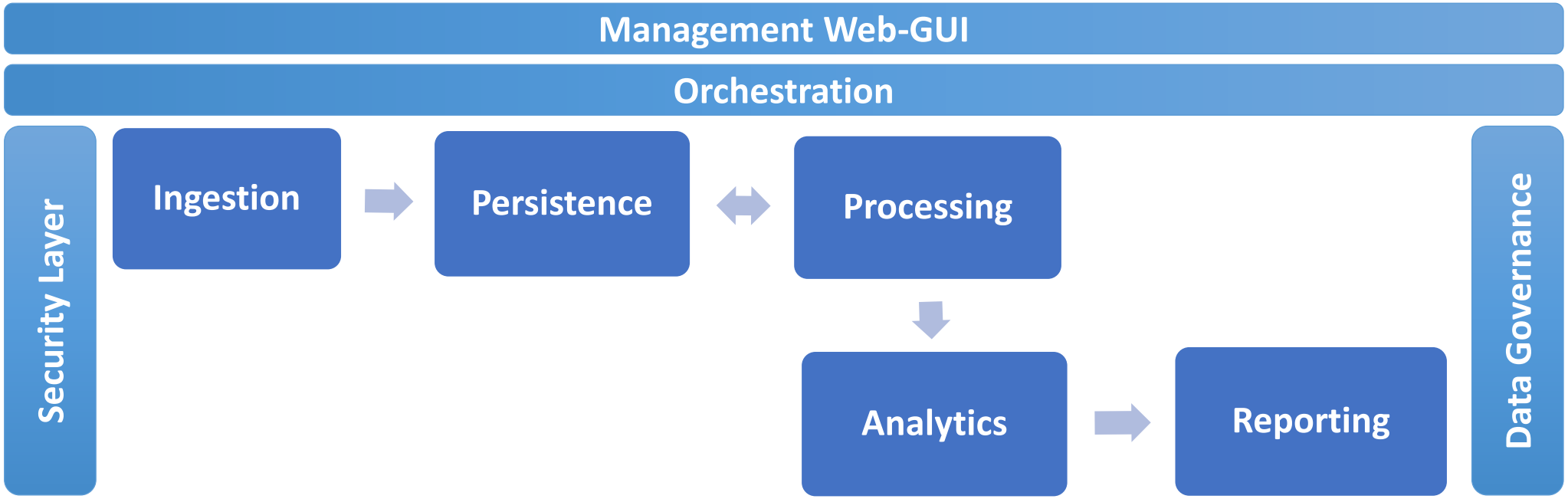
Features

- The use of medium / low cost HW, still obtaining good calculation skills.
- Failure management (fault-tolerance).
- Performance optimization via SW.
- Guarantee speed of execution even in the processing of numerous terabytes of data.
- Allow horizontal scalability;
- Provide a high level of availability
- The ability to receive unstructured data without depending on a fixed and predefined schema.

Big Data Architecture
High Level Schema

To define the architecture of the system, it is a common convention to use a block diagram

In particular, **the blocks group** are **based on the main functionality**.

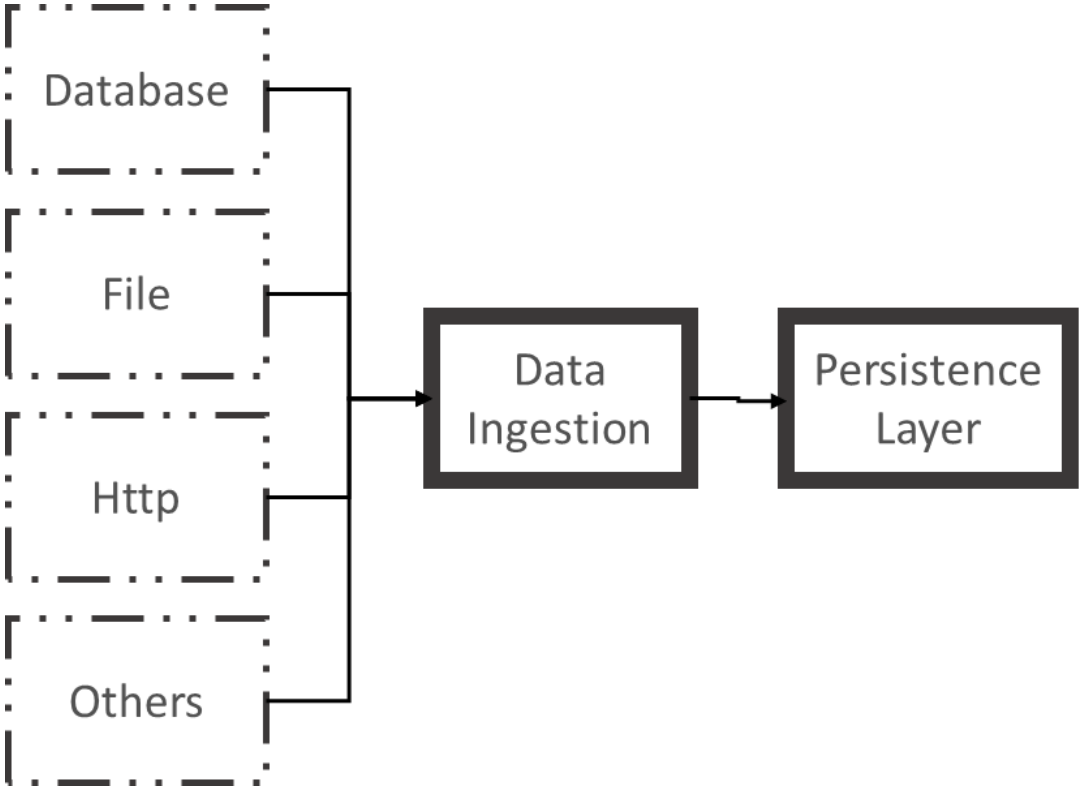


Big Data Architecture
Data Ingestion

First step of the architecture, it **allows the acquisition of data, coming from one or more sources** and with **different formats**, and to route them to the correct destination.

Heterogeneous sources
Is essential to use tools that allow the acquisition from heterogeneous sources therefore provide for different types of data:

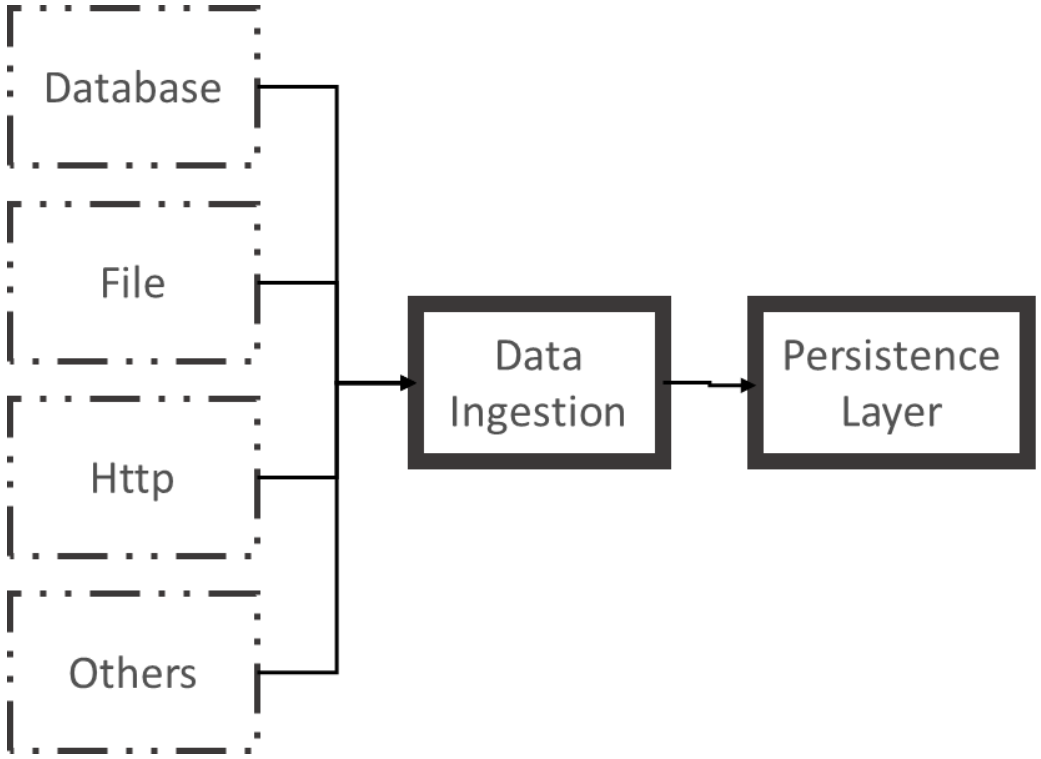
- **Structured: data** from relational databases (oracle, mysql, sql server)
- **Semi-structured**: e.g. import CSV or JSON files, No-SQL databases such as Cosmos DB or Mongo DB
- **Unstructured**: such as log data, videos, images, or free text



Big Data Architecture
Data Ingestion

Ingestion mode
Two main modes of ingestion:

- **Batch**: where data is collected and used in scheduled mode
- **Real-Time**: each event as soon as available is immediately sent to the next layer of the architecture trying to ensure low latency



Big Data Architecture

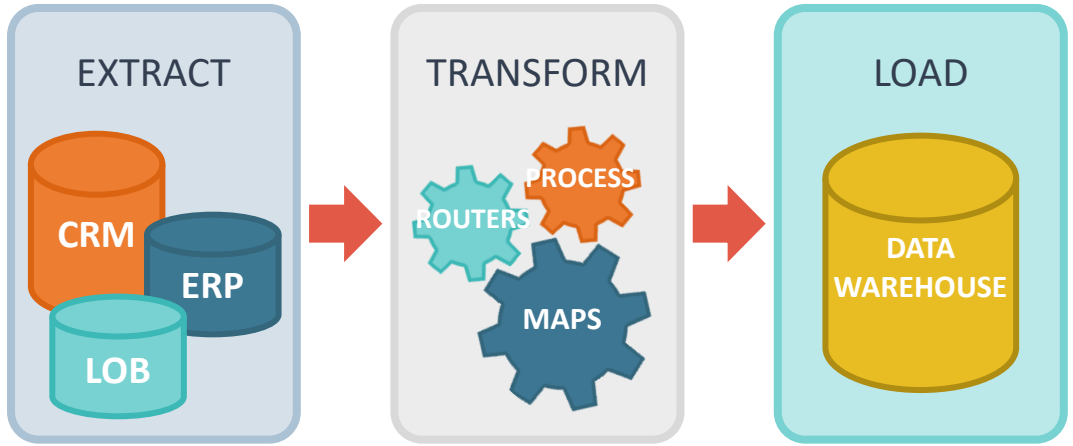
Data Ingestion: From ETL to ELT

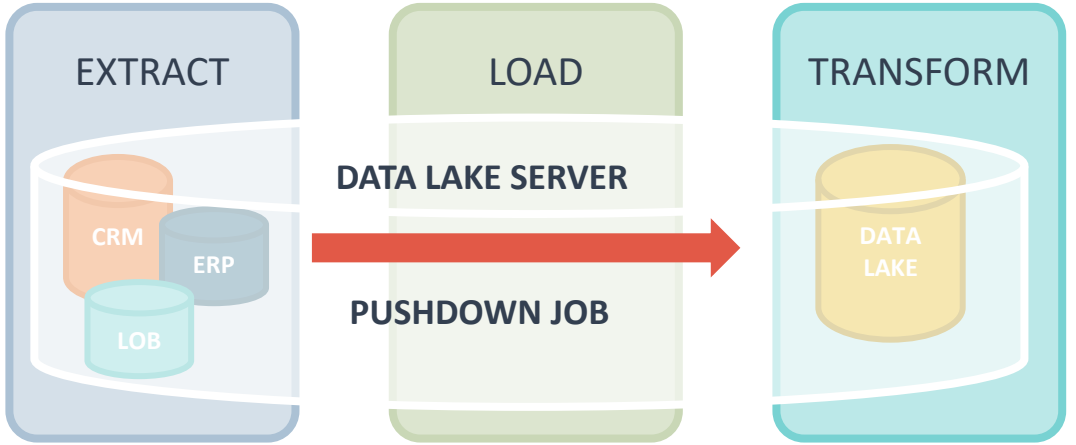
ETL

Traditional systems (DWH) use an extract, transform, load (ETL) procedure in which data was taken from the source, manipulated to fit the properties of a target system, then added to that system. In this scenario, **the major work is to prepare the data before it is loaded into the system**

ELT

Big Data platforms, with ELT paradigms, allow data engineers to skip previous transformations and load all of the organization's raw data into the data lake. Data scientists can define transformations (not only in SQL language) and execute them in the data lake.





Big Data Architecture
Persistence

Responsible for storing data and information throughout their life cycle (from raw to processed data obtained after the processing phase in which they are transformed and enriched with useful information).

Types of storage systems

Also in this case, in view of a Big Data architecture it is necessary to provide for the storage of heterogeneous data types and according to the volume of the latter and their characteristics.

Big Data Architecture
Persistence

Types of storage systems

- Distributed file system (es HDFS) collects platform data in their heterogeneity, constituting both the deep lake (raw data) and processed data layer (ETL and / or ELT)
- non-relational database: the type of database is chosen according to the type of semi-structured data that will be stored and the use that will be made of such data
- relational databases: while presenting performance limits, this technology is used to store structured data from the source RDBMS allowing to maintain a strong integrity and consistency of the data, usually maintaining a lower volume of data

Big Data Architecture
Data Processing

These components are responsible for **processing the acquired data** and storing it.

The way of working

- **batch type**: these are ELT type processing that takes place at a programmed frequency in a well-defined time interval.

- **The near real time processing mode**, often called stream processing, is typically achieved through a stream or continuous flow of data, which favors an event-driven approach.

Main elaborations

The main processes that the Processing Layer will be in charge of are:

- Dataset analysis and acquisition;
- Harmonization and data remediation;
- Transformation of data in order to make them uniform and consistent for other processing and for display;

Big Data Architecture
Analytics

Extract knowledge from data

Big data analytics is the use of advanced analytic techniques against very large, diverse data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes

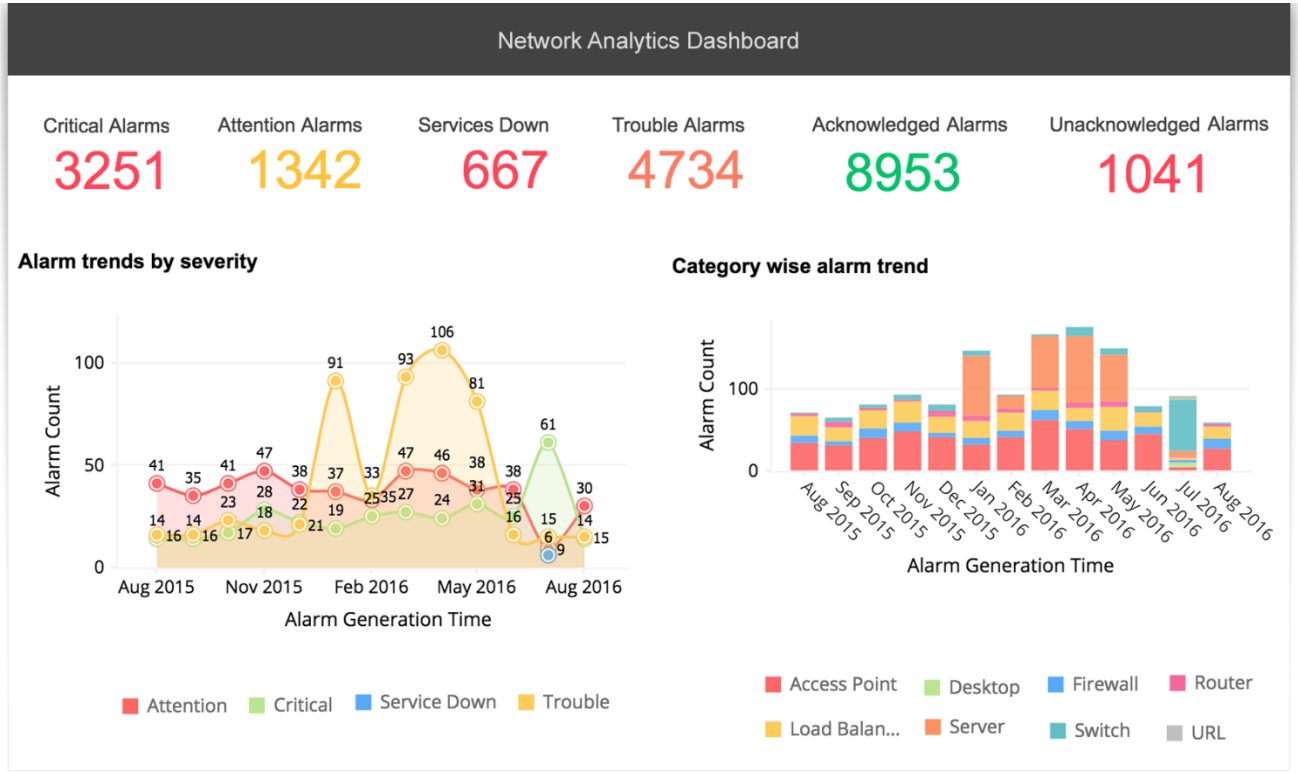
Analysis of big data allows analysts, researchers and business users to make better and faster decisions using data that was previously inaccessible or unusable. Businesses can use advanced analytics techniques such as **text analytics, machine learning, predictive analytics, data mining, statistics and natural language processing** to gain new insights from previously untapped data sources independently or together with existing enterprise data.

Big Data Architecture
Reporting

Present the data

The reporting component is responsible for **presenting the data** processed by the processing and analysis tools in the form of **graphs** and **dashboards** in order to make the information easily usable.

Reporting tools provide **interactive dashboards that add additional functionality** to those of mere data consultation (example Drill-down function, which allows users to navigate through the various hierarchical levels of the dimensions)

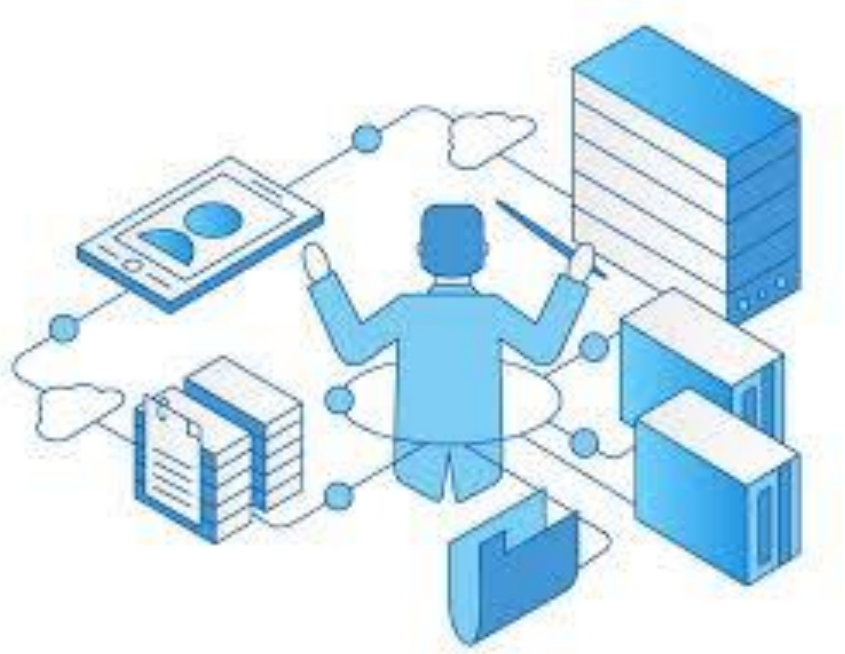


Big Data Architecture
Orchestration

Definition
Orchestration is the configuration, management and automatic coordination of computer systems, applications and services.

It's a methodology that helps IT teams to manage complex tasks and workflows more easily.

Orchestration tools
The orchestration process comes into play when these activities need to be performed in a particular order with certain security groups / tools, role assignments and permissions.



Big Data Architecture
Security

Why data security is important
Data security means protecting digital data, from unauthorized users and from unwanted actions such as a cyber attack or data breach.

Security objectives
- Authentication of users and services
- Granular authorization to perform a specific action and / or operation
- Standardize the authorization method
- Access control based on role and attributes
- Centralize user access control and administrative actions within the data ecosystem

GDPR
The General Data Protection Regulation (GDPR) is a European regulation that governs the way in which companies and other organizations process personal data.

Big Data Architecture
Data Governance

Data governance (DG) is the process of managing the availability, usability, integrity and security of data in business systems, based on standards and criteria that also control data usage.

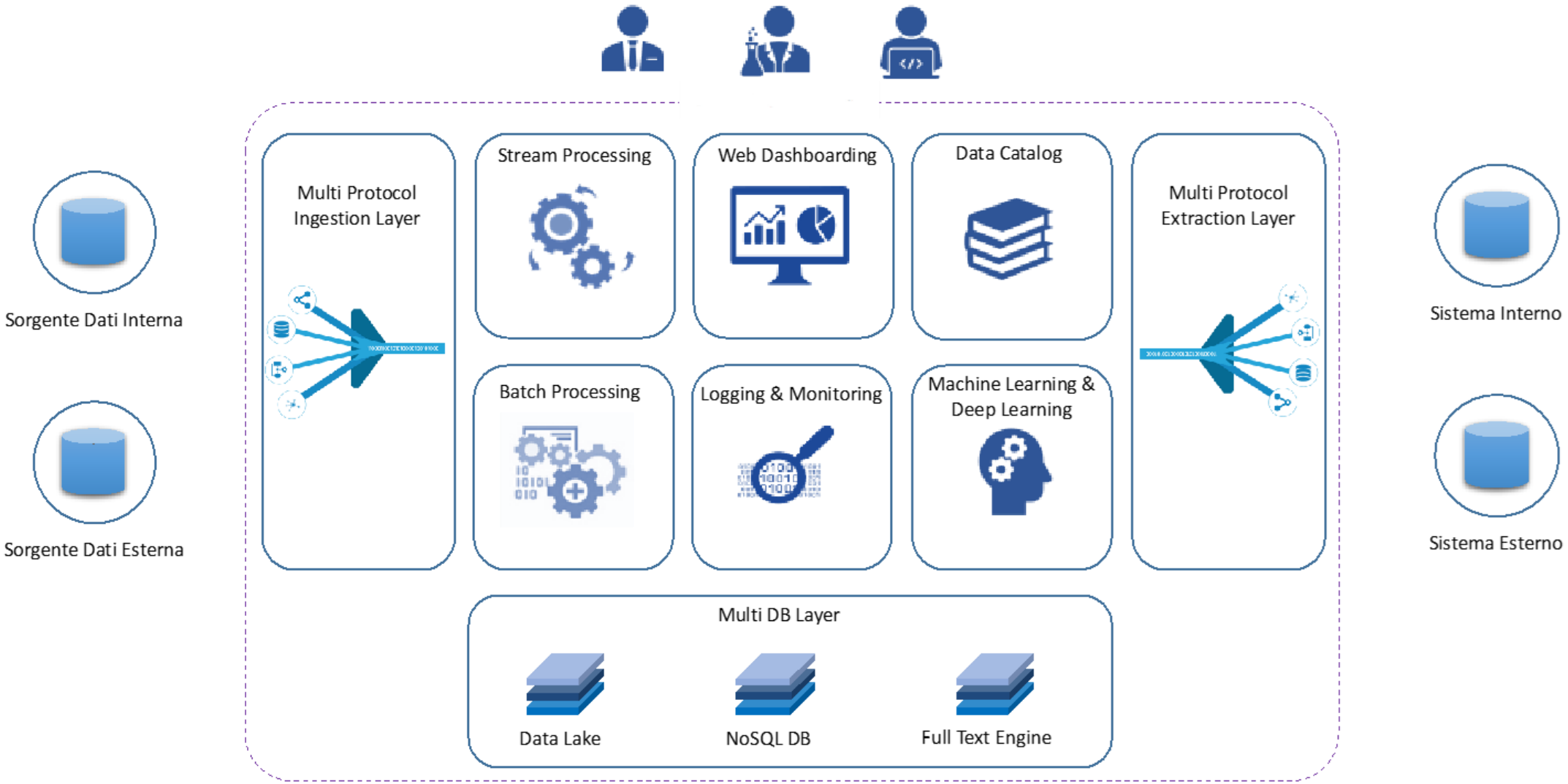
Because it's important

Effective data governance ensures that data is consistent and reliable and is not misused.
Without governance, data inconsistencies may not be resolved. For example, customer names may be listed differently in the sales, logistics, and customer service systems. This could complicate data integration efforts and create data integrity issues that impact the accuracy of business intelligence (BI), business reporting, and analytics applications.

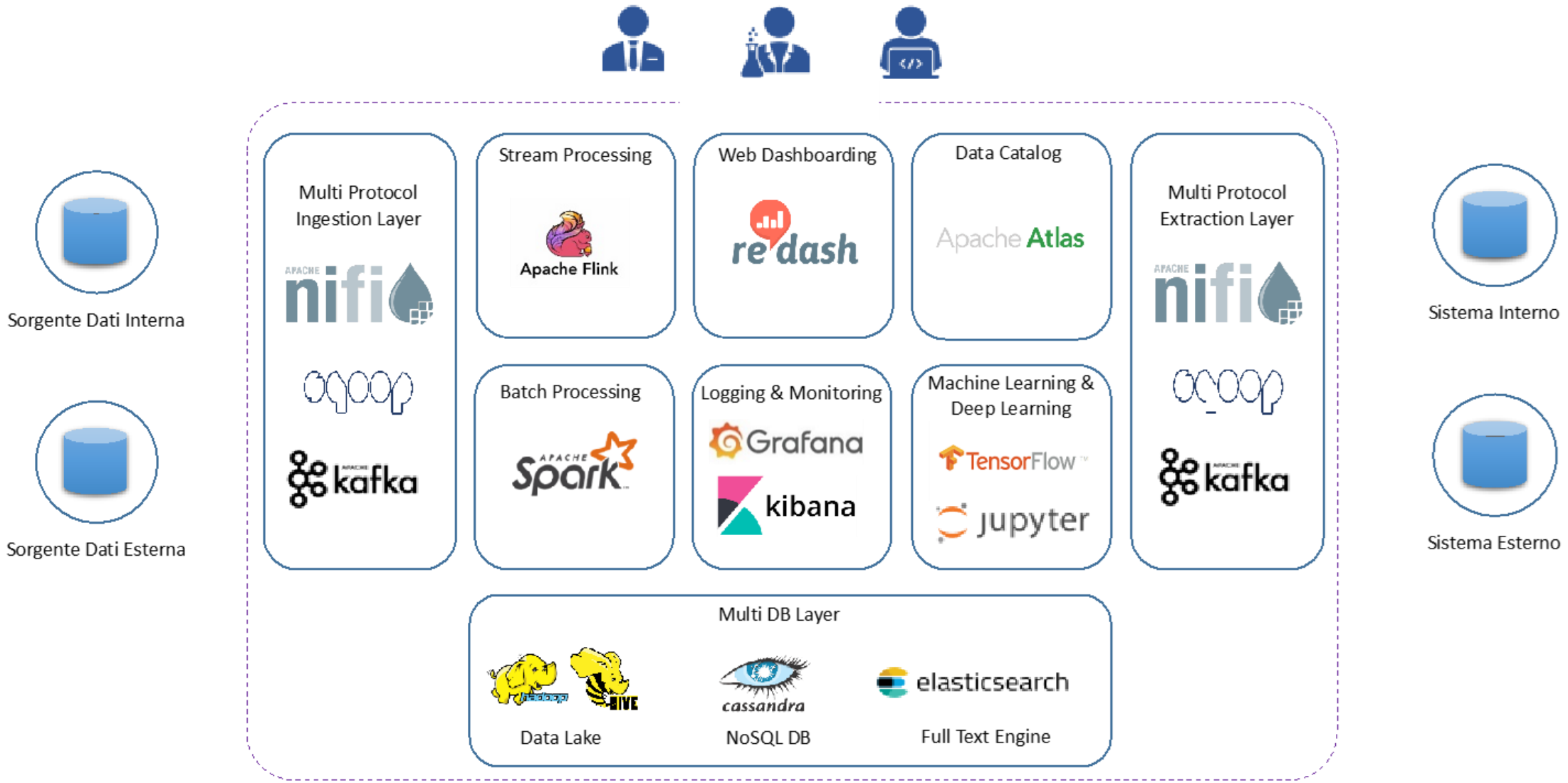
Goals and benefits

- Ensure that the data is used correctly
- Increase the quality of the data
- Improve business decision making

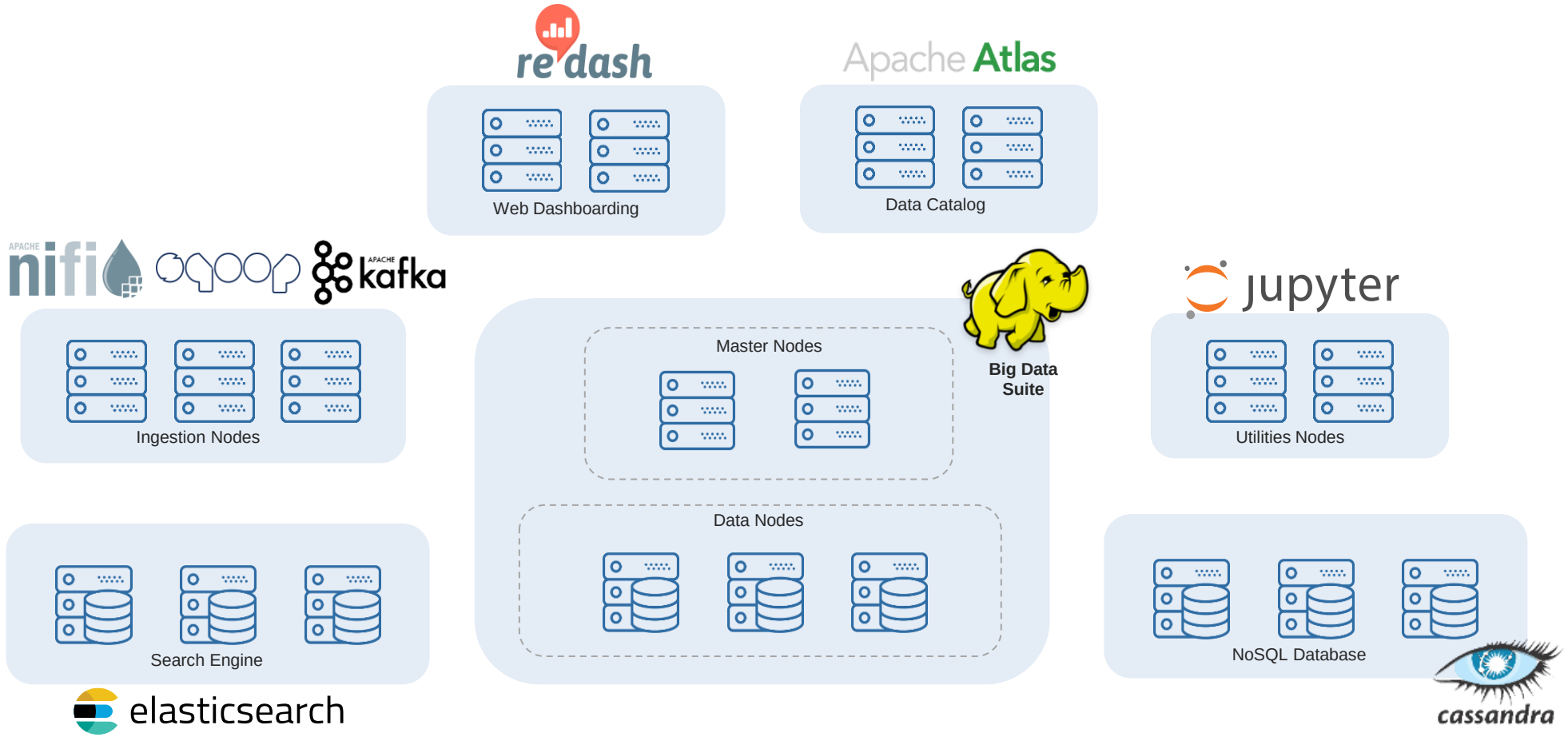
Big Data: Example of Logical Architecture



Big Data: Example of Technological Architecture



Big Data: Example of Physical Infrastructure



Big Data & AI
Example of Job Opportunities

Job Title	Description
Data Analyst	A data analyst gathers and organizes large volumes of data for predictive models or statistical analysis. They use this analysis to arrive at business conclusions such as cutting costs and reducing the price of products
Industrial Engineer	The job of an industrial engineer is to improve their employer's production processes using statistical process control.
Qualitative Analyst	A qualitative or financial analyst forecasts changes in the valuation of financial instruments like bonds and stocks
Economist	The job of an economist is to study wealth creation and transfers, as well as utilize data analytics to project how future economic trends will look
Digital Marketer	Digital marketers give a company insight into marketing campaigns and promotions when launching a new product or service. They gather this insight by analyzing data
Data Scientist	Interpret data, provide solutions, and uncover insight from an abundance of data. Data scientists build new processes or models that will reveal new information that is more useful for their employer.
Machine Learning Engineer	He is the solution architect responsible for the design of Artificial Intelligence architectures and their use in ICT contexts
Data Architect	Data architects build databases and design analytics applications that improve the way data is stored, organized, and visualized

Big Data: Use Case
Dynamic Insurance Pricing

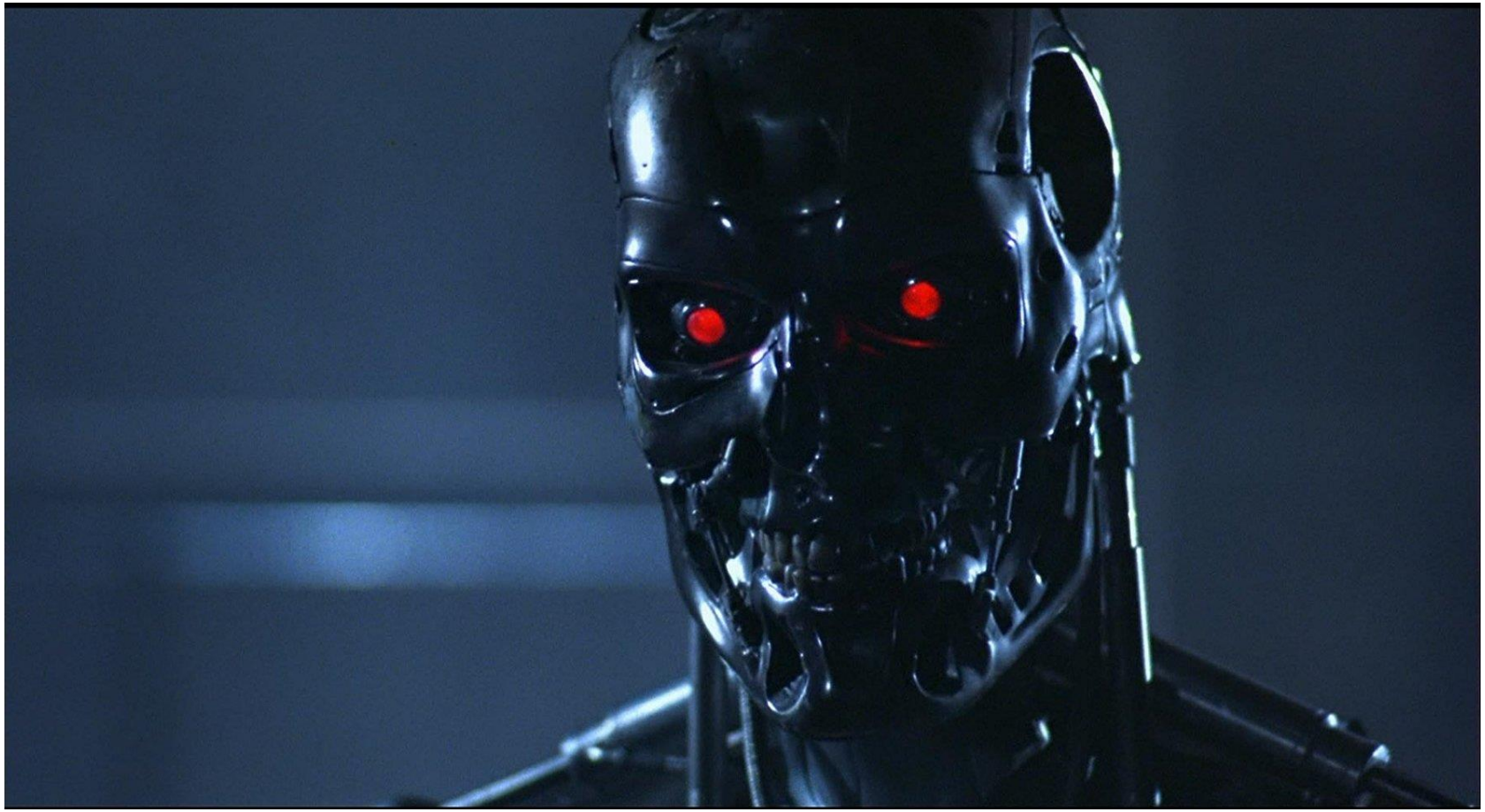
Data Type	Target
IoT, Black Box Data (Speed, Brake ecc)	Calculation of customized rates according to the insurance risk
Personal Data (age, sex, state of health)	
Geographic Data (travel information)	
Vehicle information	
Residential Score Index	

Big Data: Use Case
Healthcare: Precision Medicine

Data Type	Target
Imaging Data (RX, Tac, Ecography)	Preventing pathologies and clinical complications
Personal Data (age, sex, state of health)	
Blood analysis	
IoT Sensor (Pacemaker, blood pressure meter)	
Consumer device (Smartwatch)	

What is Artificial Intelligence (AI)?

... in the collective imagination



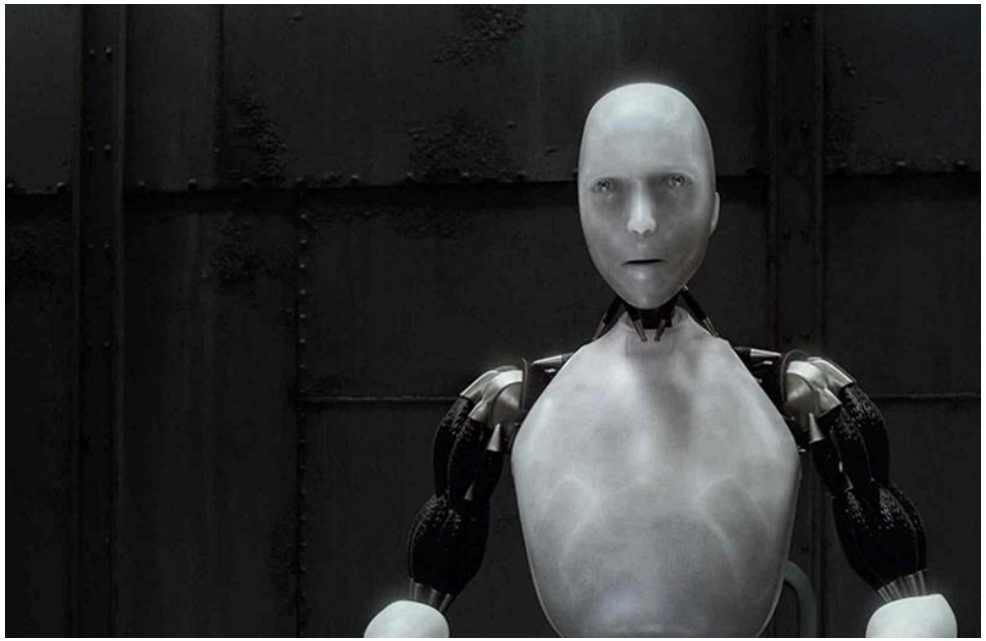
Source: ImDB

What is Artificial Intelligence (AI)?

A big goal: to create autonomous intelligent AI
– non necessarily a robot

«*AI begins with an ancient desire to forge gods*»

Machines who think, 1979
Pamela McCorduck



Source: ImDB, Amazon

AI types

ANI

Artificial Narrow Intelligence

«Limited» artificial intelligences able to learn and perform a single task (or a few)

AGI

Artificial General Intelligence

«Generic» artificial intelligences capable of learning and executing virtually any task and generalizing

They are the ultimate goal in the industry

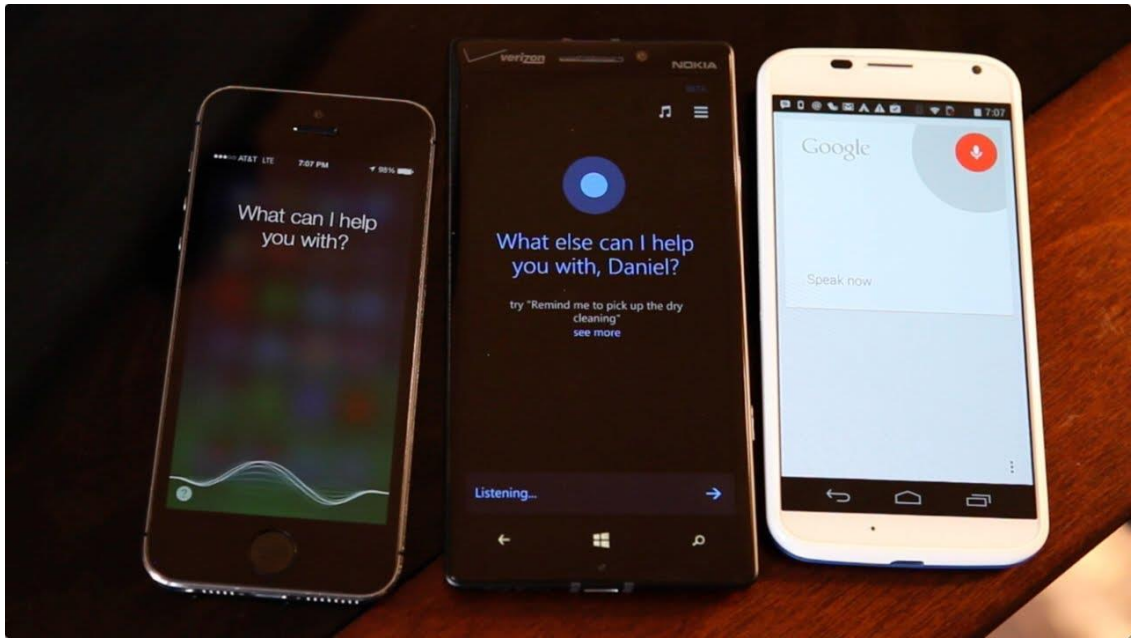
ASI

Artificial Super Intelligence

Generic intelligences far superior to the human one

What is Artificial Intelligence (AI)?

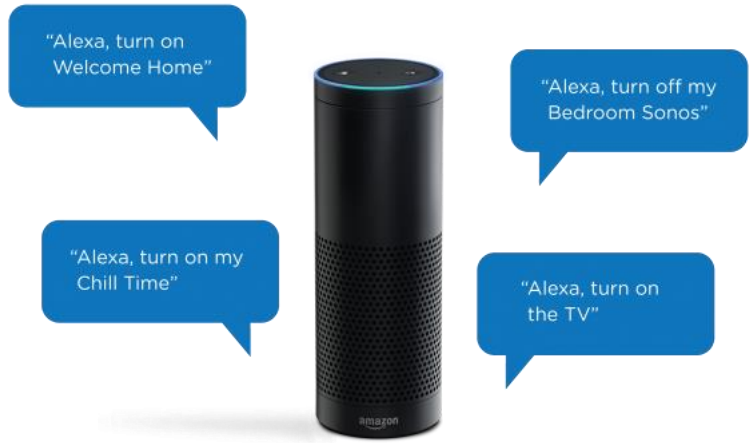
An intermediate goal: to create SW that behaves intelligently



"Remind me to call Mom when I get home"

"add milk to the shopping list"

"show me how to get to the station"



What is Artificial Intelligence (AI)?

«*Artificial intelligence applies advanced analysis and logic-based techniques, including machine learning, to interpret events, support and automate decisions, and take actions.*»

[Gartner 2022]

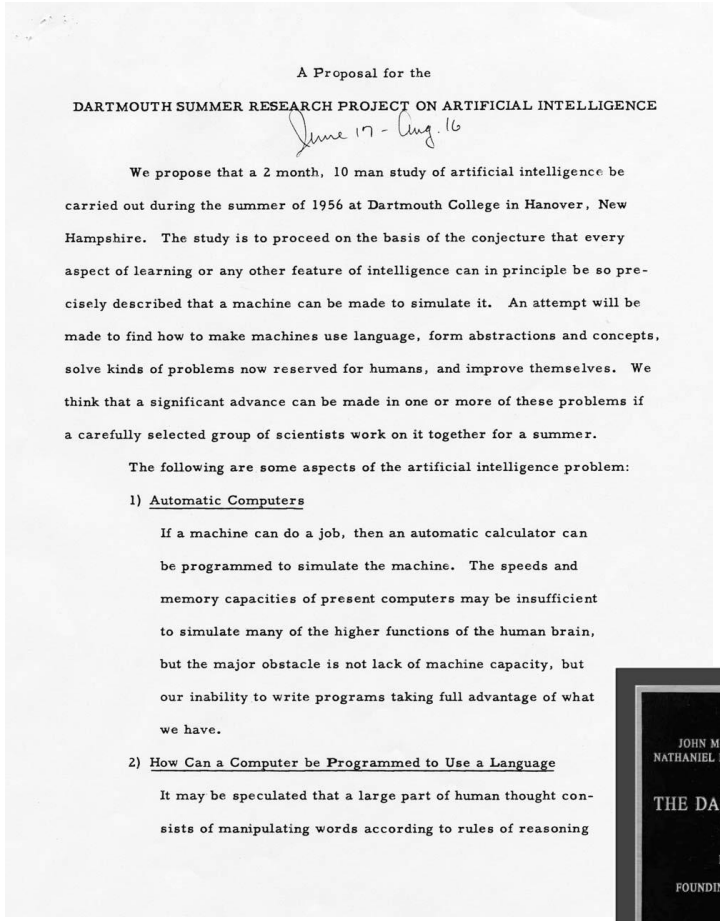
The 2022 Gartner CIO and Technology Executives Survey identified that 96% of respondents indicated that they either had AI in their deployment pipelines or had initiated projects; among those, 27% reported that they have already deployed those techniques.

AI: Birth (and manifest)

1955: *A PROPOSAL FOR THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE*

J. McCarthy, Dartmouth College
M. L. Minsky, Harvard University
N. Rochester, I.B.M. Corporation
C.E. Shannon, Bell Telephone Laboratories

«The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.»



A Proposal for the

DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

June 17 - Aug. 16

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

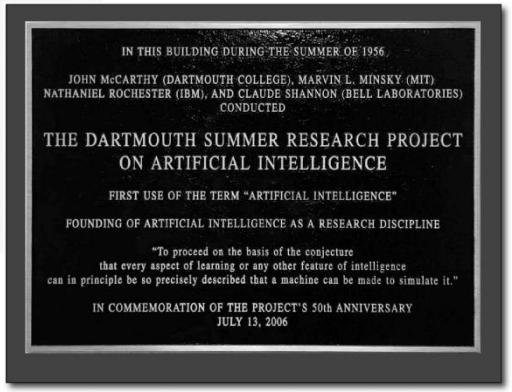
The following are some aspects of the artificial intelligence problem:

1) Automatic Computers

If a machine can do a job, then an automatic calculator can be programmed to simulate the machine. The speeds and memory capacities of present computers may be insufficient to simulate many of the higher functions of the human brain, but the major obstacle is not lack of machine capacity, but our inability to write programs taking full advantage of what we have.

2) How Can a Computer be Programmed to Use a Language

It may be speculated that a large part of human thought consists of manipulating words according to rules of reasoning



IN THIS BUILDING DURING THE SUMMER OF 1956

JOHN McCARTHY (DARTMOUTH COLLEGE), MARVIN L. MINSKY (MIT)
NATHANIEL ROCHESTER (IBM), AND CLAUDE SHANNON (BELL LABORATORIES)
CONDUCTED

THE DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

FIRST USE OF THE TERM "ARTIFICIAL INTELLIGENCE"

FOUNDING OF ARTIFICIAL INTELLIGENCE AS A RESEARCH DISCIPLINE

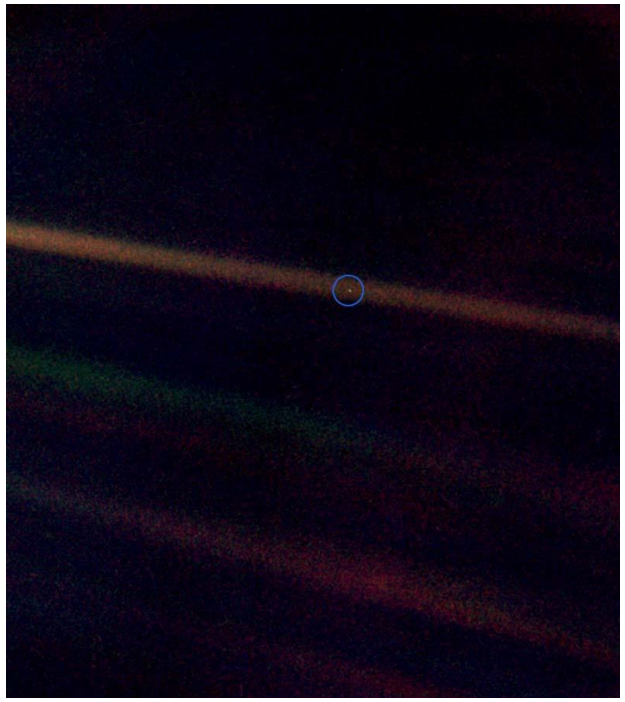
"To proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it."

IN COMMEMORATION OF THE PROJECT'S 50th ANNIVERSARY
JULY 13, 2006

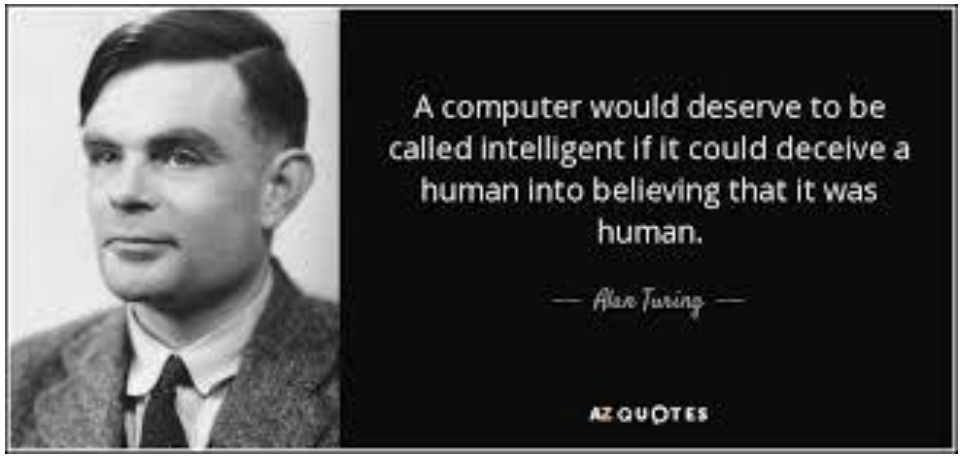
1956: Workshop at Dartmouth College

https://ojs.aaai.org/index.php/aimagazine/article/view/1904/1802
https://www.aaai.org/ojs/index.php/aimagazine/article/viewFile/1911/1809

AI in the context of (human) history



- Universe: 13.8 Bil. years ca.
- Earth: 4.5 Bil. years ca.
- «Modern» man: 300.000 years ca.
- Civilization: 12.000 years ca.
- Writing: 5.000 ca.



1951: «*It seems probable that once the machine thinking method had started, it would not take long to outstrip our feeble powers… They would be able to converse with each other to sharpen their wits. At some stage, therefore, we should have to expect the machines to take control.*»

Source: https://magazine.xpert.tv/alan-turings-4-most-powerful-quotes/

AI successes

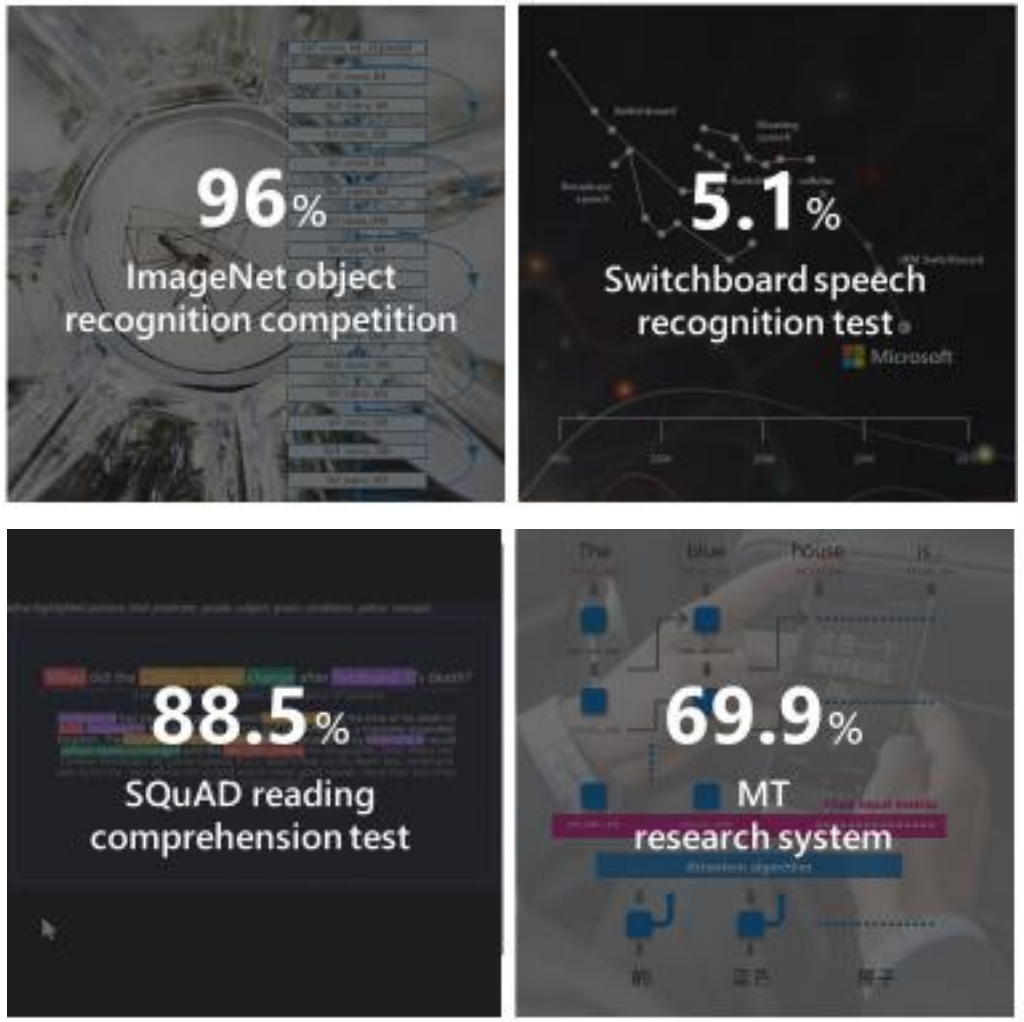
1997: Kasparov vs Deep Blue (IBM)

AI successes

AlphaGO	Lee Se-dol
1202 CPUs, 176 GPUs,	1 Human Brain,
100+ Scientists.	1 Coffee.

2016: Lee Sedol vs AlphaGo (DeepMind)

AI successes

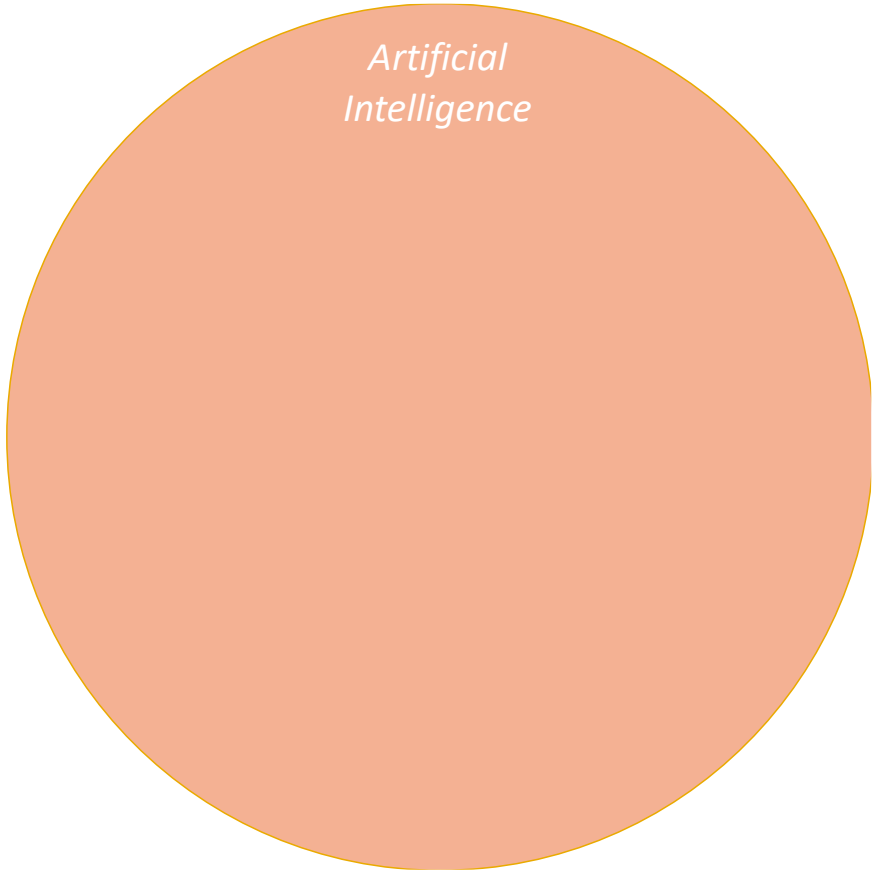


2016-2018: Cognitive Research

Let’s represent AI

Artificial Intelligence (AI)

A broad discipline with the aim of creating intelligent machines, as opposed to the natural intelligence of humans and animals. It has become an umbrella term that nonetheless captures the industry's long-term ambition to build machines that emulate and thus surpass the full gamut of human cognition.

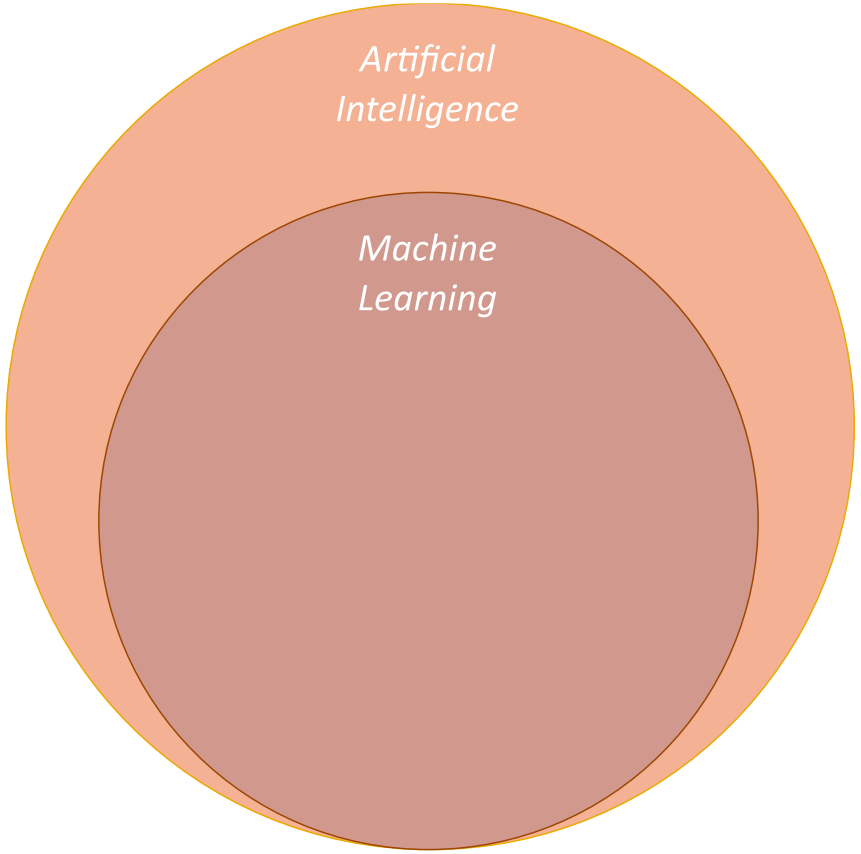


Let’s represent AI

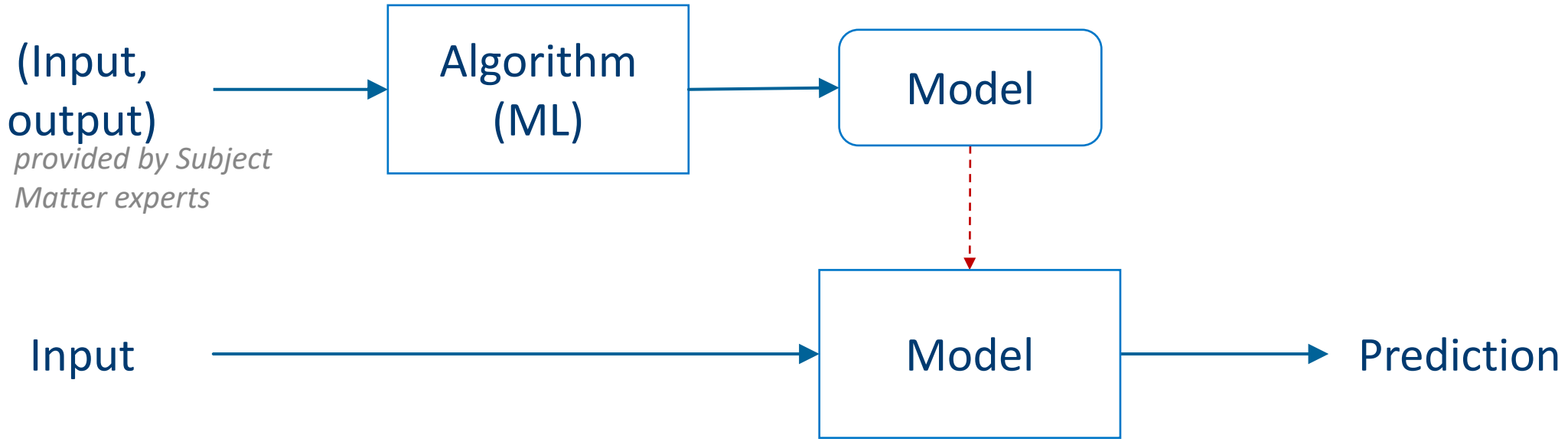
Machine learning (ML)

«*Field of study that gives computers the ability to learn without being explicitly programmed*»
(A. Samuel, 1959).

It is a subset of AI that also uses statistical techniques to give machines the ability to "learn" from data. This process is known as "training" a "model" using a learning "algorithm" that progressively improves the performance of the model on a specific task.



AI e Machine Learning (ML) vs traditional programming



AI e Machine Learning (ML)

How can a computer learn without explicit programming activity?

Must «observe» examples of a task

- Algorithm powered with real examples
- Statistically extracts models from data
- Models are used for future examples

How does it work in practice?

- Simplified idea to the maximum of what is the problem from the mathematical point of view that lies behind this type of prediction
- E.g .: predict a user's vote on a new product based on the history of his purchases
- The aim: to determine a list of products related to the tastes of the user himself
- The key data for this type of problem are:
  - the users;
  - products or items;
  - votes or preferences, also known as ratings.

Ratings Matrix

How does it work in practice?

- Intuitively: some users have similar tastes
- With a small matrix it is don «by eye»
- Think about the number of movies available on Netflix or the number of Amazon products and multiply them by the number of subscribers

	Mr. Robot	*Stranger Things*	*Friends*	*Westworld*
Alice	5	4		2
Bob	1	2	5	
Carla	4		3	5
Davide		5	1	1

How does it work in practice?

- indicator that is used:
  - Similarity between two users
- The definition of this function is a fundamental element for the success of a hint system
- **Similarity** is used to predict the vote
- The result is a very different tip from person to person!

Function: inputs two users and returns a real number representing their similarity

$s: U \times U \rightarrow R$ $s: U \times U \rightarrow R$

Artificial Intelligence algorithms

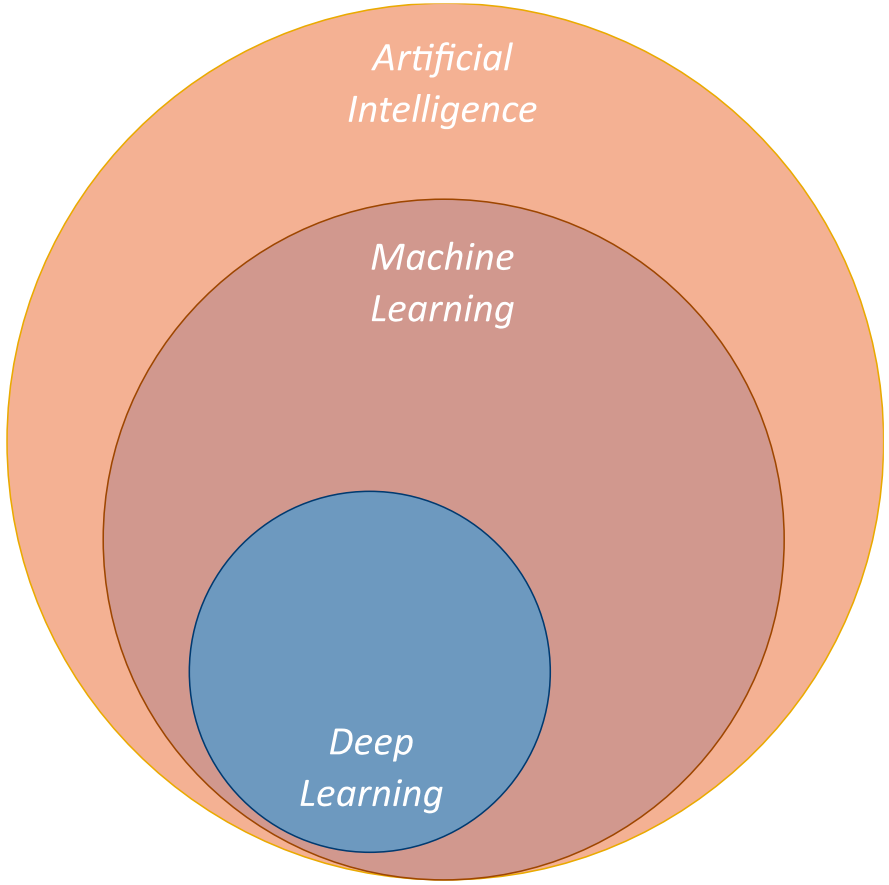
- The first era of AI focuses on a top-down, or **symbolic**, approach:
  - Logic systems, ontologies, rule systems, declarative architectures.
  - E.g .: a circle is described on the basis of its mathematical properties (declarative), or by means of a method to draw it with a compass (procedural)
- The rebirth of AI is due to a change of approach: bottom up, or **connectionist**.
  - There are aspects that forma reasoning is unable to grasp (perception, images, pixels, senses, environment)
  - E.g.: Concept of circumference learned implicitly from examples

Let’s represent AI

Deep learning (ML)

An area of the ML that attempts to mimic the activity in layers of neurons in the brain to learn to recognize complex patterns in the data.

«Deep» refers to the large number of layers of neurons in contemporary ML models that help learn data-rich representations for better performance



Let’s represent AI

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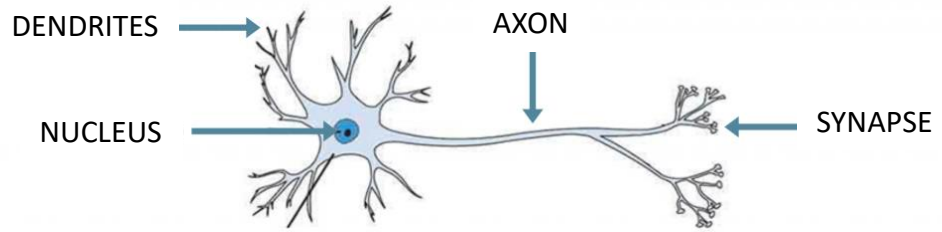
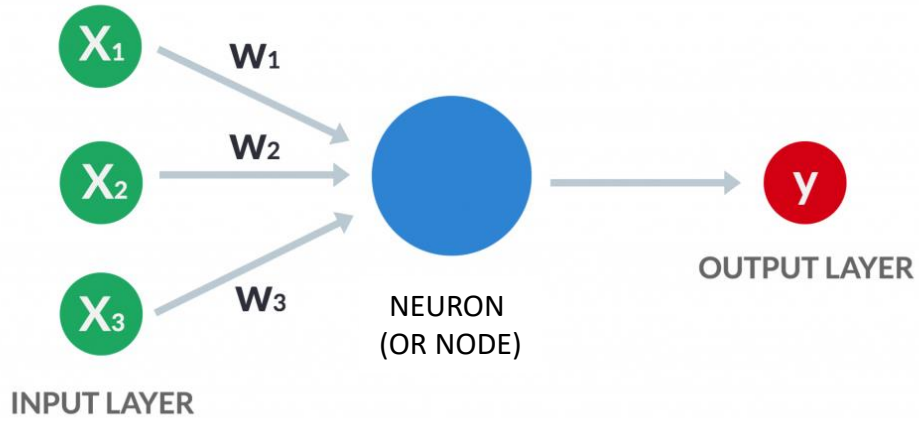


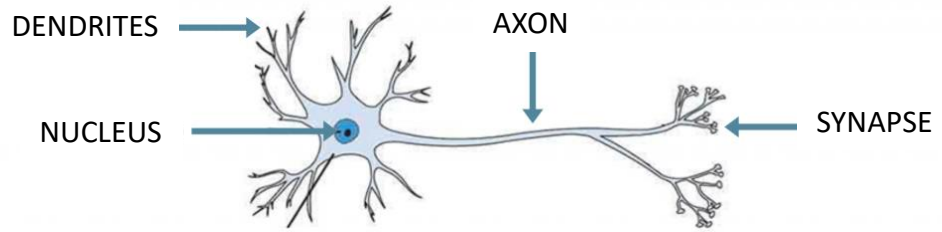


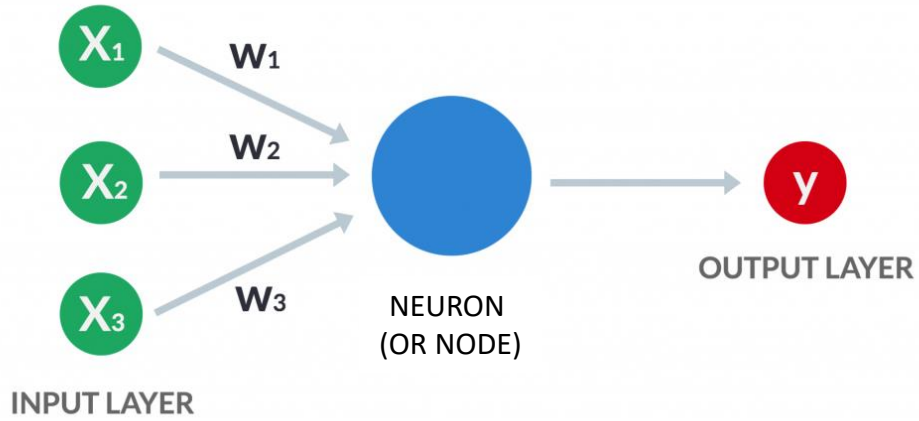
Machine Learning Algorithms: Neural Networks

- Deep Learning (or Deep Neural Network)

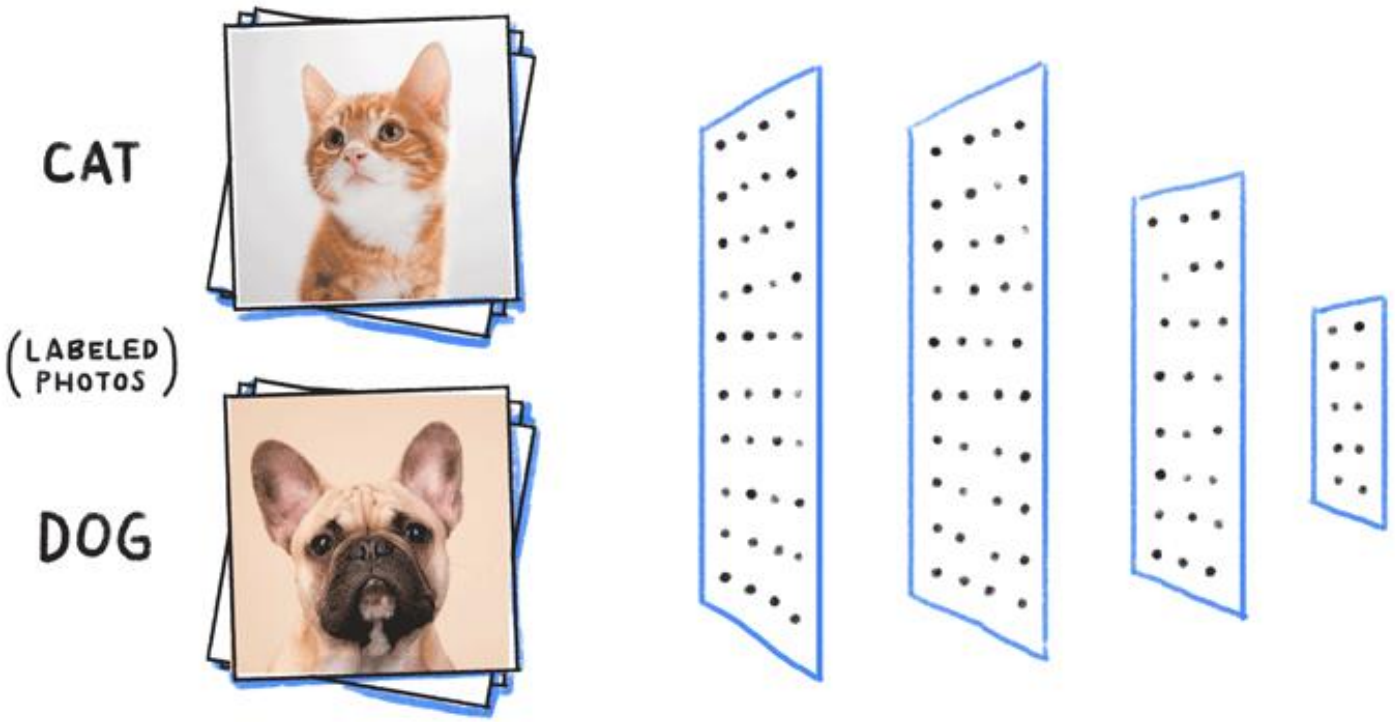
is the class of algorithms on which there is currently a lot of attention

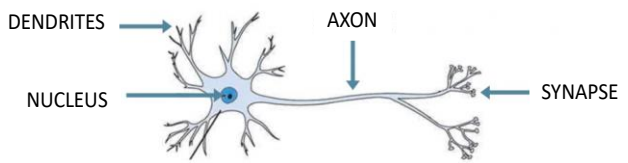
  - It has enabled significant advances in AI applications
  - Based on neural networks, a technology known since the 1950s (Psycological Review, Rosemblatt 1958)
  - It is based on the construction of artificial neural networks
  - The rebirth of NNs, with recent discoveries is due to the growing amount of available data (big data) and the increase in computing capacity (GPU, TPU)

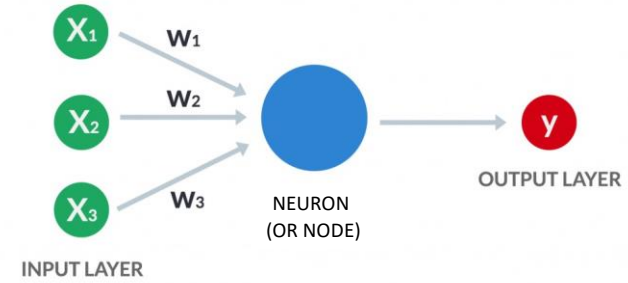




Machine Learning Algorithms: Neural Networks

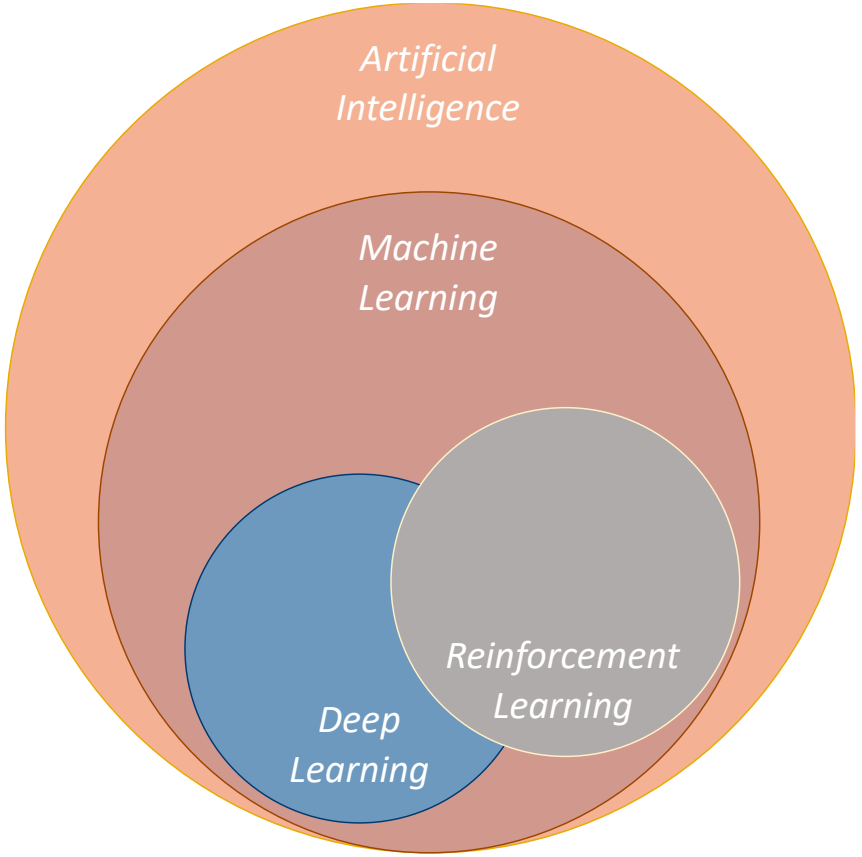




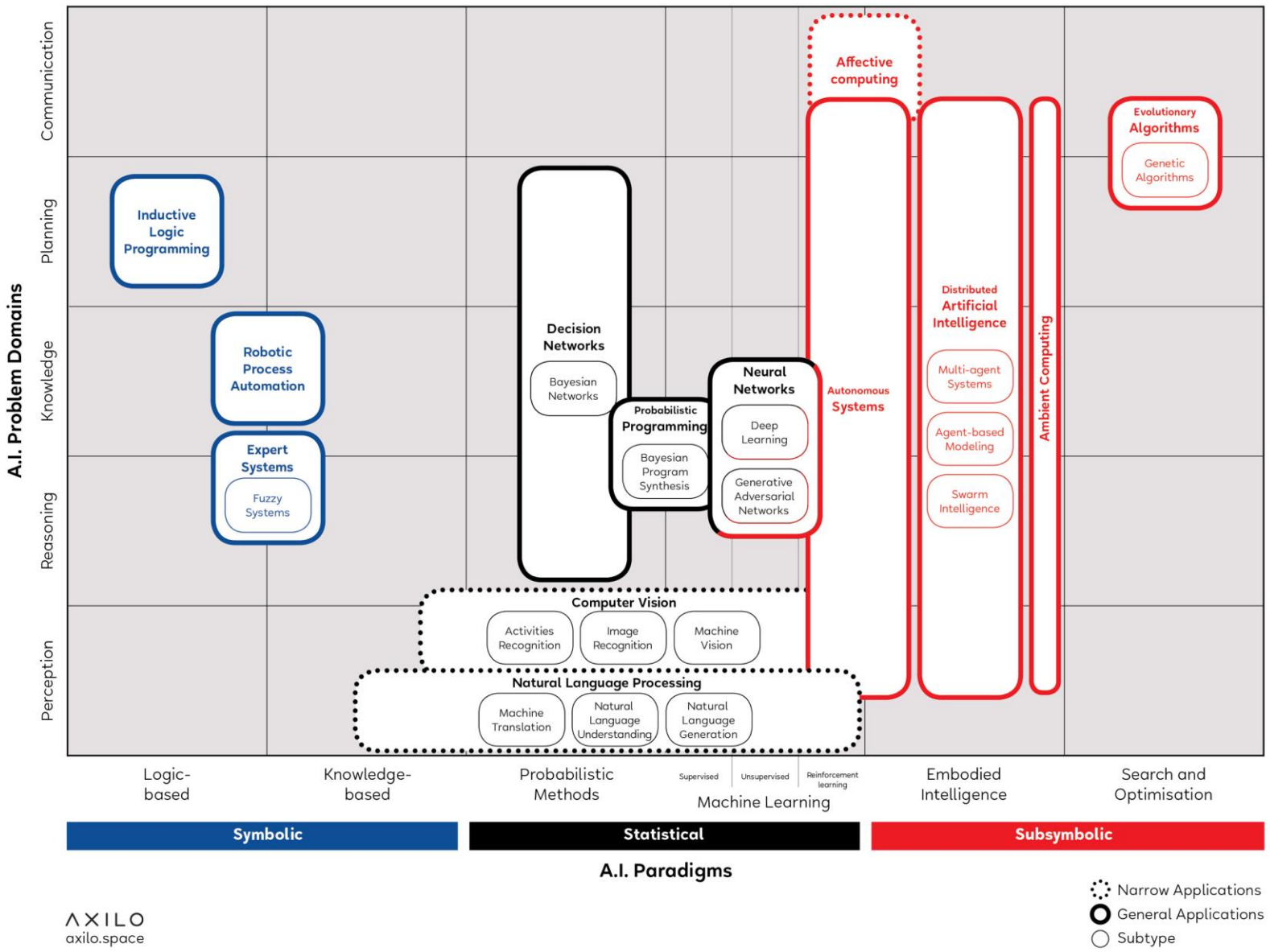


Reinforcement learning (ML)

An area of the ML interested in developing software agents that learn goal-oriented behavior by trial and error in an environment that provides **rewards** or **penalties** in response to the agent's actions (called a "**policy**") toward achieving that goal.



Classification of AI technologies



Paradigms:

- *Logic-based*
- *Knowledge-based*
- *Probabilistic methods*
- *Machine learning*
- *Embodied intelligence*
- *Search and optimization*

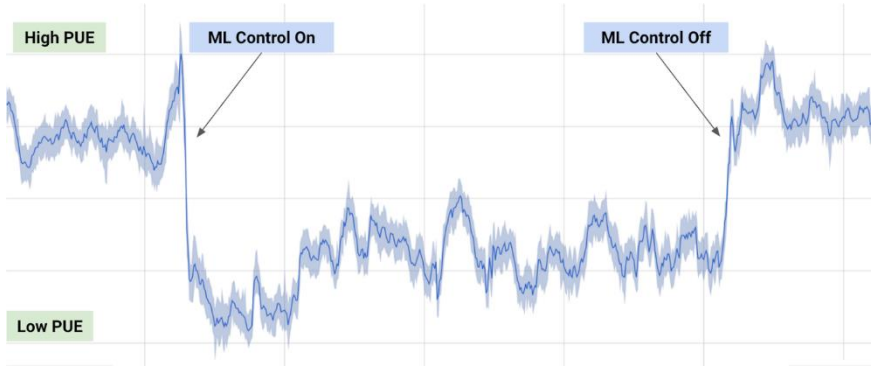
Examples of applications and relevant advances in "statistical" approaches

- Face recognition
- Image Classification
- Handwriting transcription
- Speech / Voice recognition
- Spam filtering
- Text to Speech
- Machine Translation
- Sentiment analysis

- Medical diagnosis
- Car: driving assistance
- Virtual assistants
- Online ads, Search, social recommendations
- Games with Reinforcement Learning

Some examples of AI

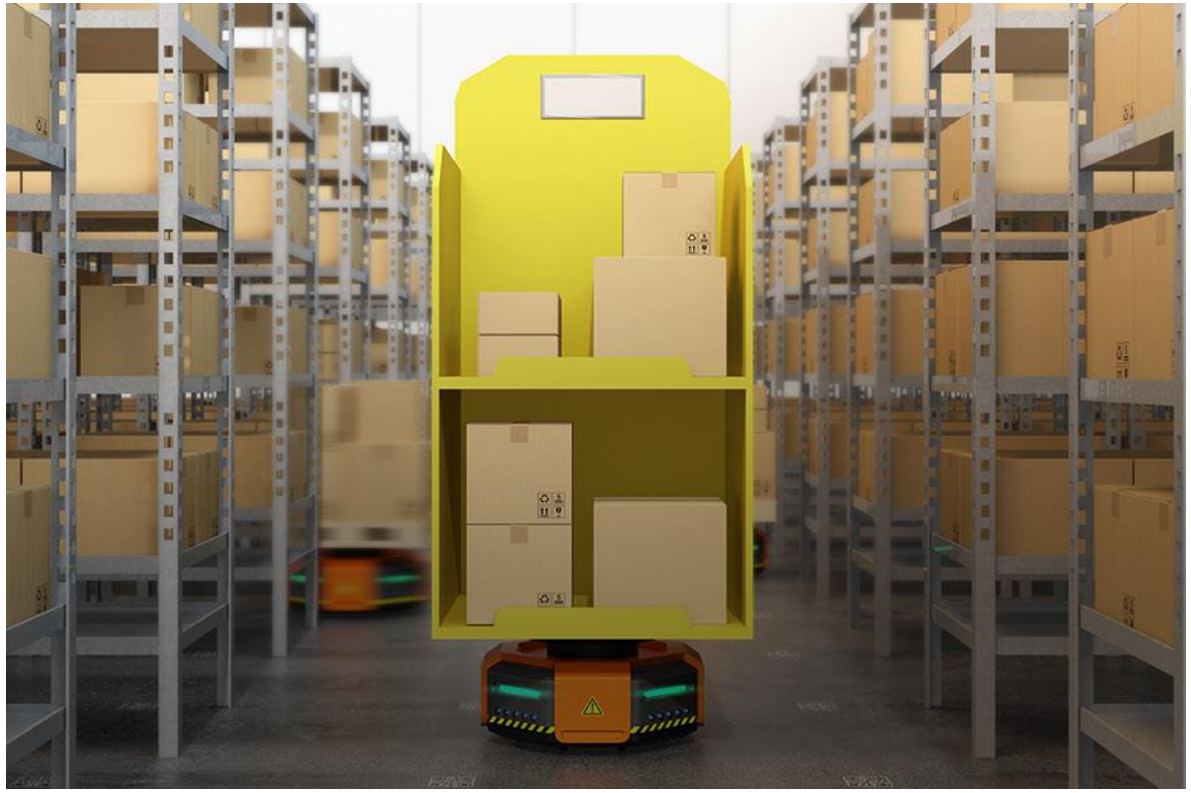
DeepMind AI Reduces Google Data Centre Cooling Bill by 40%



Some examples of AI

Amazon uses Computer Vision systems that analyze images to securely track where each item is in warehouses.

Each pod has approximately nine rows of shelves to hold products on all four sides, and each warehouse typically ranges between 60,000 and 100,000 square feet



Some examples of AI

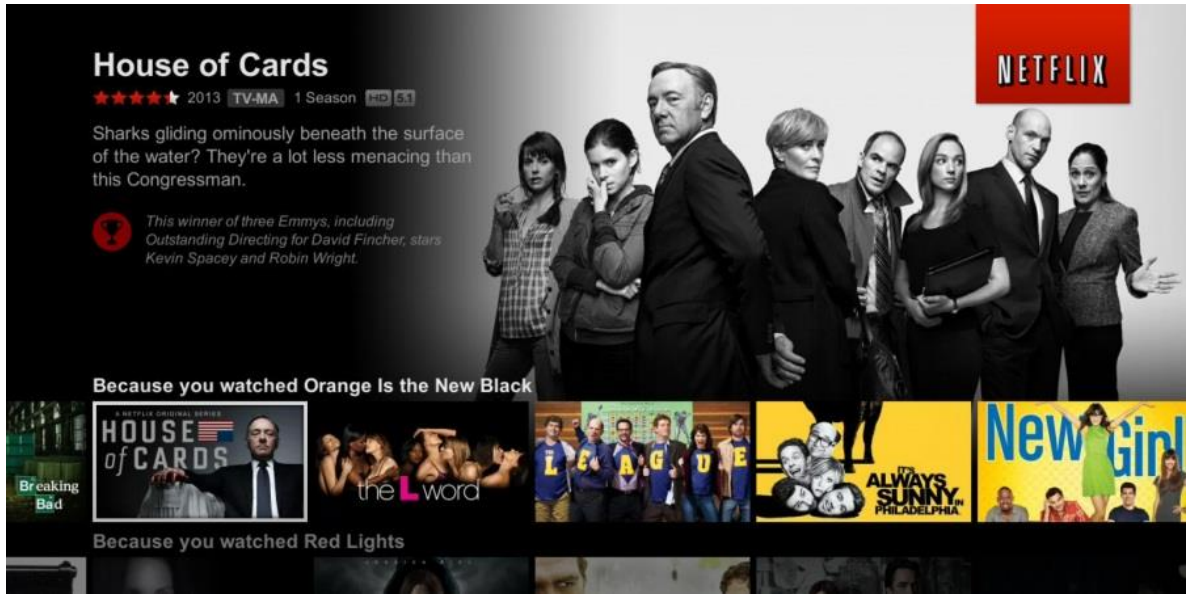
Bosch and Samsung roll out Smart Digital Factories to reduce energy consumption and waste

Some examples of AI

Recommendation systems

For example, they can learn what we like to watch on TV, what we usually listen to on the radio or order in restaurants.

Who uses them? Virtually everyone (Amazon, Facebook, Netflix, Spotify, Youtube…)



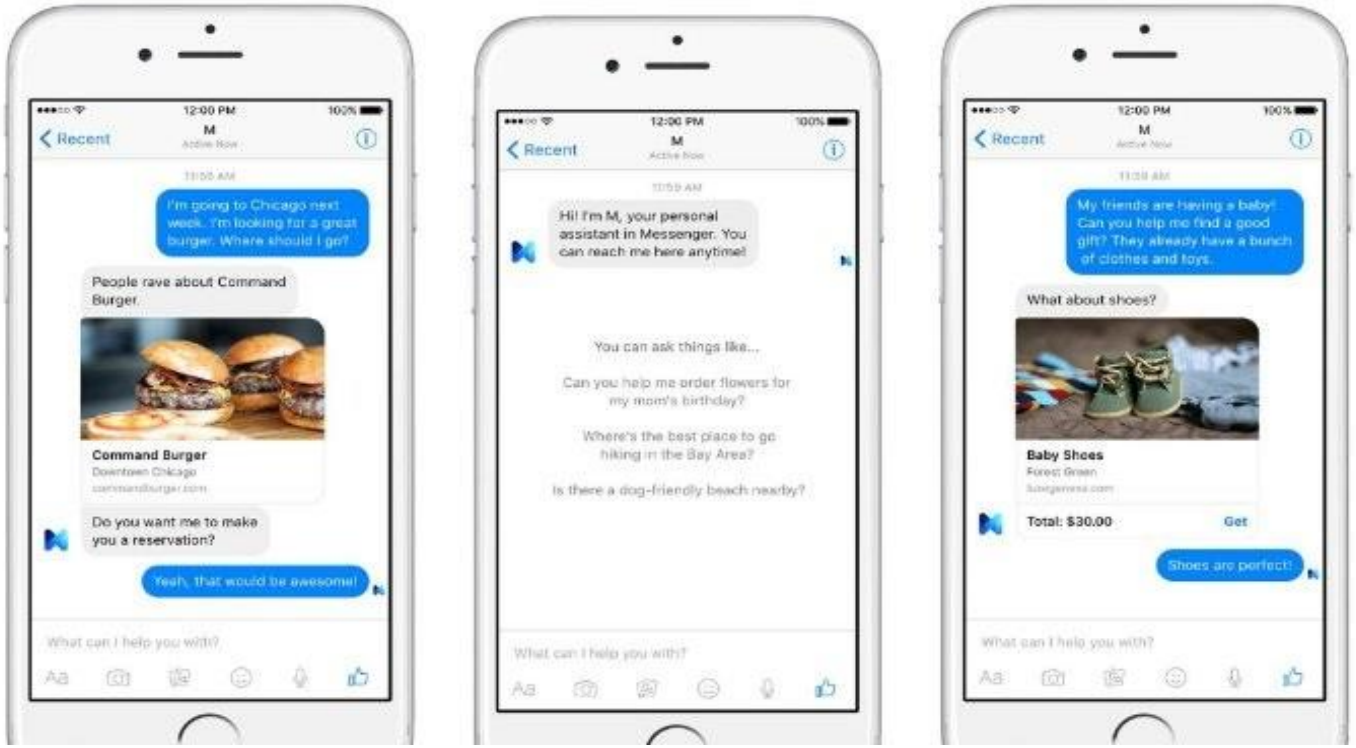
Some examples of AI

Some examples of AI

Customer support via chat

To understand what the customer is asking them and provide the most appropriate answer.

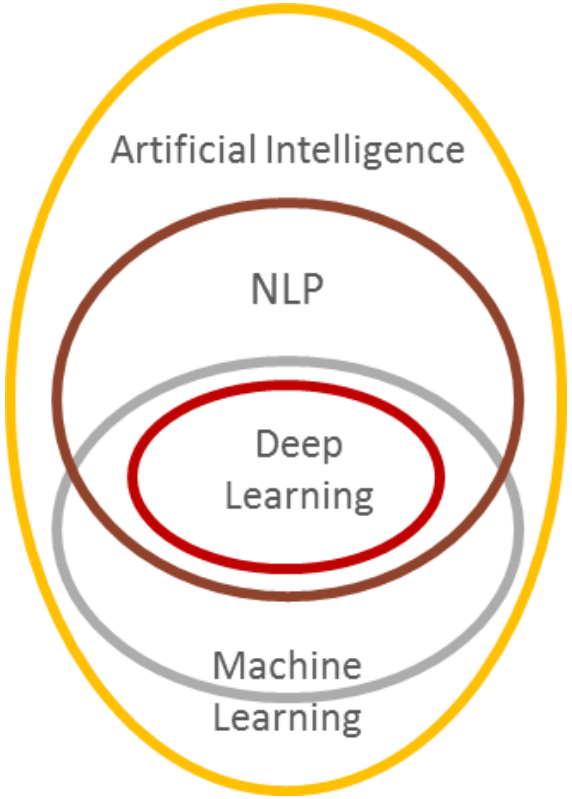
Challenge for these systems, as well as for virtual assistants: **be able to understand natural language**



AI is not magic

Complexity in NLP (Natural Language Processing)

TW: Rome – Pisa 5 hours!



San Jose cops kill man with knife

Text Paper Translate Listen Close

San Jose cops kill man with knife

Ex-college football player, 23, shot 9 times allegedly charged police at fiancee's home

By Hamed Aleaziz and Vivian Ho

A man fatally shot by San Jose police officers while allegedly charging at them with a knife was a 23-year-old former football player at [illegible]

Thursday.

Police officials said two officers opened fire Wednesday afternoon on Phillip Watkins outside his fiancee's home because they feared for their lives. The officers had been [illegible]

that, it turned out, had been made by Watkins himself.

But the mother of Watkins' fiancee, who also lives in the home on the 1300 block of Sherman Street, said she witnessed the shooting and do[illegible]

shortly after she called a suicide intervention hotline in hopes of getting Watkins medical help.

Watkins' 911 call came in at 5:01 p.m., said Sgt. Heather Randol, a San Jose police spokeswoman. "The caller stated there was a male breaking into his home armed with a knife," Randol said. "The caller [illegible]

ed help from police."

She said Watkins was on the sidewalk in front of the home when two officers got there. He was holding a knife with a 4-inch blade and ran toward the officers in a threatening manner, Randol said.

"Both officers ordered the suspect to stop and drop the knife," Randol said. "The suspect [illegible]

ing for their safety and defense of their life, fired at the suspect."

On the police radio, one officer said, "We have a male with a knife. He's walking toward us."

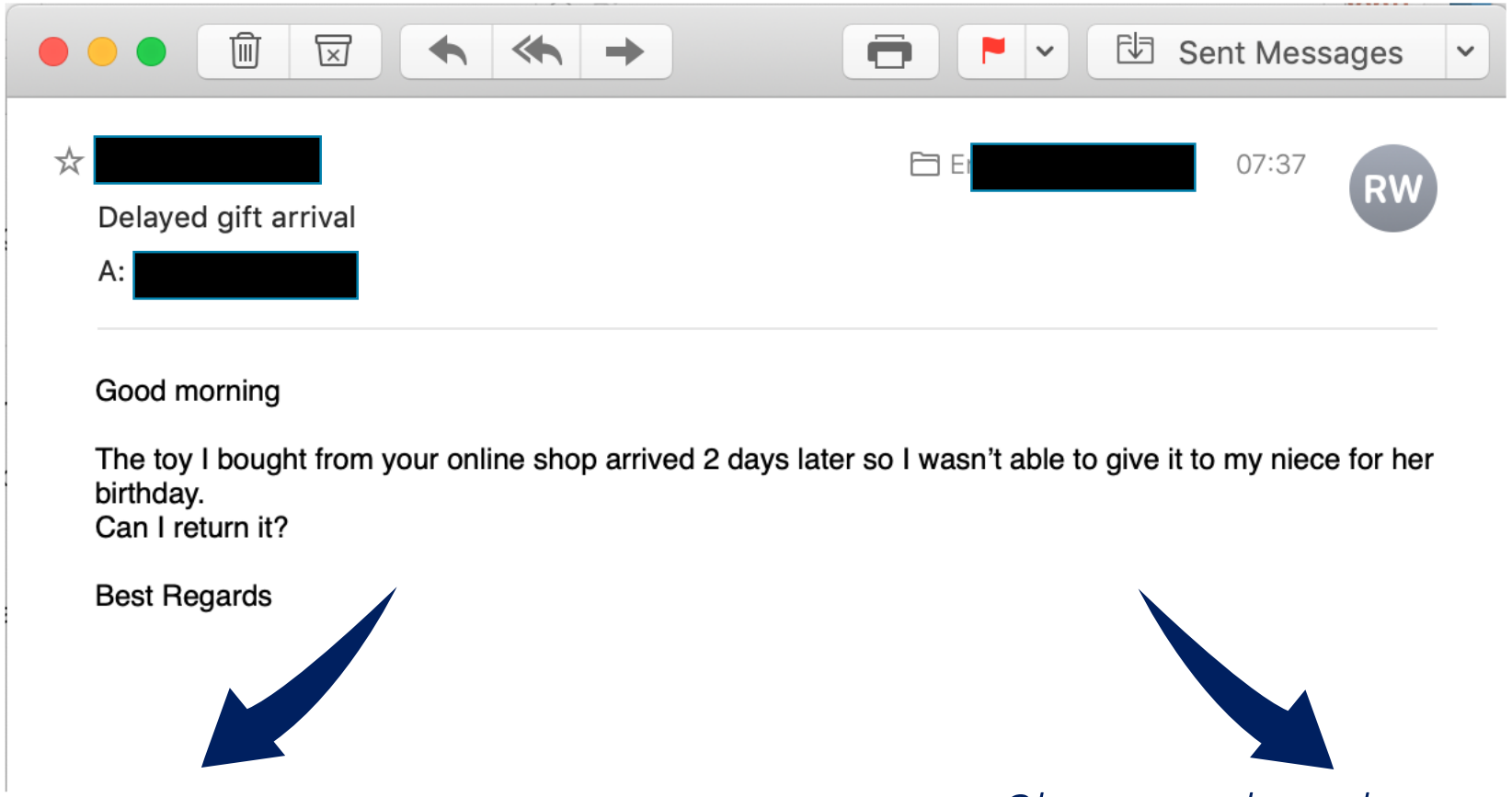
"Shots fired! Shots fired!" an officer said moments later.

A short time later, an officer reported, "Male is down. Knife's still in hand."

NLP (Natural Language Processing) is

- A multidisciplinary field:
  - Computer Science
  - Psychology
  - Linguistics
- Comprehension of language at different levels
  - Phonetics and Phonology – linguistic sounds
  - Morphology – meaning of components of words
  - Syntax – structural relationships between words
  - Semantics – meaning
  - Discourse – linguistic units larger than a single utterance

What Machine Learning can do today… and what it can't do



Classification: «Refund request»

Oh, sorry to hear that.
I hope your niece had a good birthday.
Yes, we can help with…

Input → Refund/Shipping/Order

What Machine Learning can do today… and what it can't do

Car

Car

Stop

Hitchhicker

Signaling

Object Classification

Image Segmentation

Gesture recognition

It needs high accuracy

It needs too much data

What Machine Learning can do today… and what it can't do

Diagnose pneumonia by learning from ~10.000 images

Diagnosing pneumonia by learning from 10 images taken from a chapter of a medical book that explains pneumonia

AI, Machine Learning and Deep Learning; some milestones

1943: Artificial neurons (W. Pitts, W. McCulloch)

1951: First Neural Network (M. Minsky)

1952: Machine Learning to play (A. Samuel)

1956: Darthmouth conference

1957-1962: Perceptron (Rosenblatt)

1970-1986: Backpropagation, RBM, RNN

(S. Linnainmaa, G. Hinton, J. Hopfield)

1979-1998: CNN/ConvNets, LSTM

(K. Fukushima, Y. LeCun; S. Hochreiter, J. Schmidhuber)

1980s: Reinforcement Learning

1995: Random Forest, SVM (Tim Kam Ho; C. Cortes, V. Vapnik)

1997: Deep Blue vs Kasparov

2006: «Deep Learning», DBN

2009: ImageNet

2012: AlexNet

2014: GANs, DeepFace

2016: AlphaGo

2017: AlphaZero, Capsule Netoworks

2018-2020: Transformers, BERT, GPT2-3

Trend of AI in Research

A position paper and a workshop (at NeurIPS) with leading experts in the sector (Bengio, NG, Hassabis, ...) explored several very important problems where ML techniques can be applied:

- Automatic monitoring with remote sensing (eg Deforestation, climate disasters).
- Scientific discovery (eg New battery materials, carbon capture).
- Systems optimization (eg reduction of food waste, consolidation of freight transport).
- Accelerate physical simulations (eg climate models and energy planning).

Tackling Climate Change with Machine Learning

David Rolnick[1]*, Priya L. Donti[2], Lynn H. Kaack[3], Kelly Kochanski[4], Alexandre Lacoste[5], Kris Sankaran[6,7], Andrew Slavin Ross[9], Nikola Milojevic-Dupont[10,11], Natasha Jaques[12], Anna Waldman-Brown[12], Alexandra Luccioni[6,7], Tegan Maharaj[6,8], Evan D. Sherwin[2], S. Karthik Mukkavilli[6,7], Konrad P. Körding[1], Carla Gomes[13], Andrew Y. Ng[14], Demis Hassabis[15], John C. Platt[16], Felix Creutzig[10,11], Jennifer Chayes[17], Yoshua Bengio[6,7]

[1]University of Pennsylvania, [2]Carnegie Mellon University, [3]ETH Zürich, [4]University of Colorado Boulder, [5]Element AI, [6]Mila, [7]Université de Montréal, [8]École Polytechnique de Montréal, [9]Harvard University, [10]Mercator Research Institute on Global Commons and Climate Change, [11]Technische Universität Berlin, [12]Massachusetts Institute of Technology, [13]Cornell University, [14]Stanford University, [15]DeepMind, [16]Google AI, [17]Microsoft Research

"*ML is part of the solution: it is a tool that enables other tools in all fields*"

Trend of AI in Research

A new generation of Transformers-based language models is bringing new improvements to the hottest area of AI: NLP

We begin to try to apply the Transformers to other contexts (eg. Computer Vision)

Huge models, large companies and huge training costs dominate the hottest area of AI today: Natural Language Processing

Biology is experiencing its «AI moment»: from medical imaging, to genetics, to proteomics, from chemistry to drug discovery

AI is mostly «closed source»: only 15% of scientific papers publish their own code, which damages the responsibility and reproducibility in AI. (https://paperswithcode.com)

Trend of AI in the Industry

The first trial of a drug discovered by artificial intelligence begins in Japan

First U.S. medical reimbursement granted for AI-based imaging procedure

The mileage of self-driving cars remains microscopic

Open data sourcing grows to create new crowdsourced solutions

Google, Graphcore, and NVIDIA continue to make major advancements in their AI hardware platforms

NLP applications in industry continue to expand their footprint and are also being implemented in Google Search and Microsoft Bing

Trend of AI in Politics and Governments

After two unlawful arrests involving face recognition, the ethical risks that researchers have warned about are brought into focus.

Semiconductor companies continue to grow in terms of geopolitical importance, most notably Taiwan's TSMC.

The US military is absorbing AI advancements from academia and industrial labs.

Nations pass laws to allow them to look into foreign acquisitions of AI companies and the UK arm will be a key test.

Nationalism and competition in AI

China: the world's largest semiconductor importer, with a total of $ 200B per year

The government has set up an additional $ 29 state fund to reduce its reliance on American semiconductor technology

China hires over 100 TSMC engineers to bridge the gap in semiconductor capabilities

- TSMC employees are offered up to 2.5 times their salary and vacation bonus
- Overall, Taiwan lost 3,000 semiconductor engineers (about 10%)

USA: The CHIPS for America Act would allocate $ 22B to subsidize US chip production.

- Over half of the advanced chips are designed in America, but only 12% are manufactured there

Given growing concerns about chips, cross-border mergers and acquisitions remain highly politicized

Source: https://www.congress.gov/bill/116th-congress/senate-bill/3933
Source: https://www.allaboutcircuits.com/news/what-the-chips-act-for-america-could-mean-for-us-semiconductor-industry/
Source: https://www.ft.com/content/ff7996bb-1309-4921-89c1-11aa8e6507de
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Source: https://www.ft.com/content/7325dcea-e327-4054-9b24-7a12a6a2cac6
Source: https://asia.nikkei.com/Business/China-tech/China-hires-over-100-TSMC-engineers-in-push-for-chip-lead

Nationalism and competition in AI

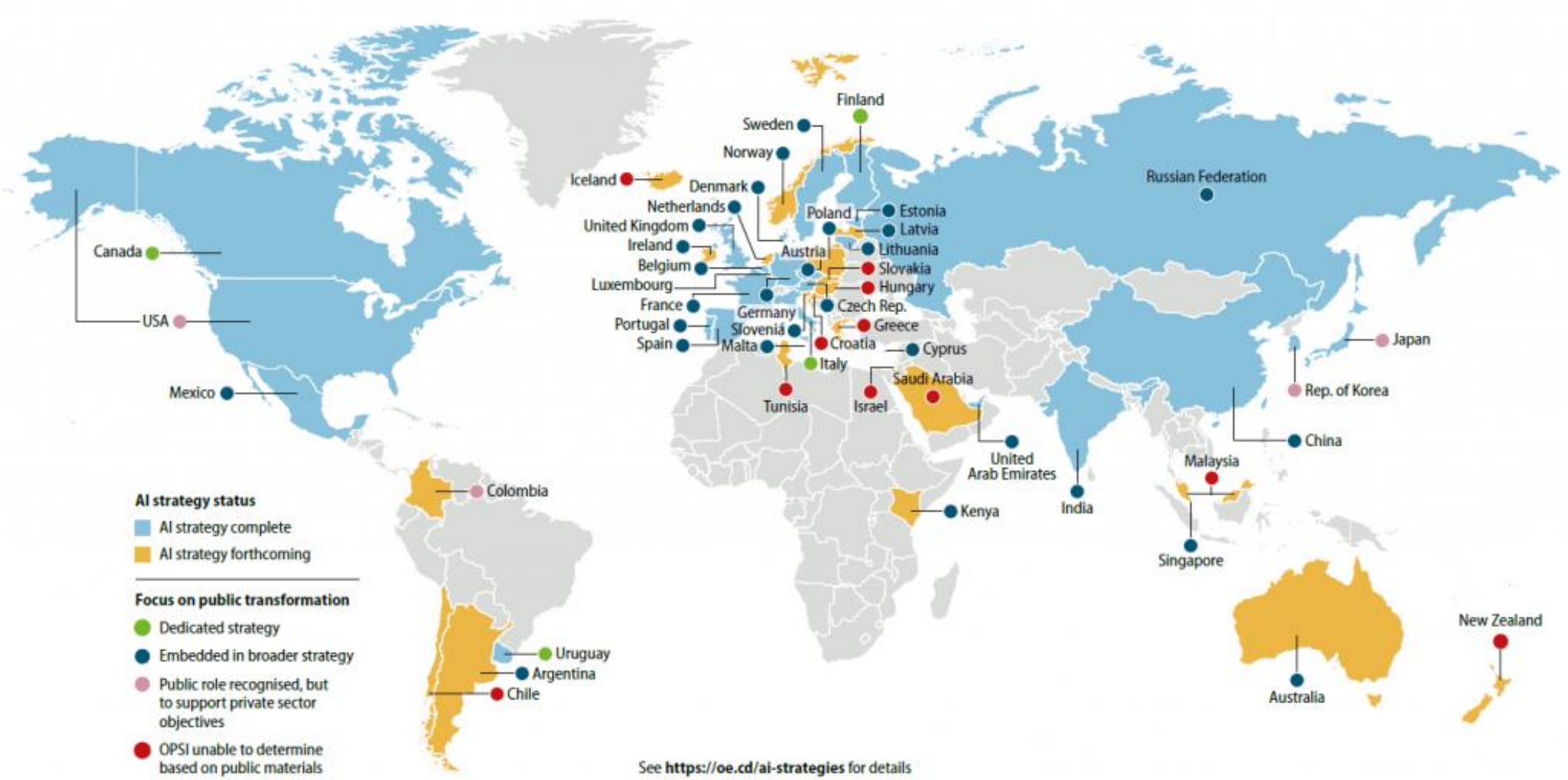
Given growing concerns about chips, cross-border mergers and acquisitions remain highly politicized

- December 2016: US and Germany block Fujian Grand Chip Investment Fund (China) $ 723 million bid for Aixtron.
- September 2017: US blocks Canyon Bridge Capital Partner (China) $ 1.3 billion bid for Lattice.
- March 2018: US blocks Broadcom (formerly Singapore-based) $ 117 billion bid for Qualcomm (US).
- July 2018: China blocks Qualcomm's $ 44 billion bid for NXP (Netherlands).
- April 2020: UK and US effectively block the full acquisition of Imagination Technologies (UK) by Canyon Bridge (China).
- April 2020: China clears US $ 6.9 billion acquisition of Mellanox (Israel).
- July 2020: Siemen's (Germany) makes an offer for Avatar (USA).
- Nvidia (USA) reported potential acquisition of Arm (UK) will be an important test of how things stand.

Source: https://money.cnn.com/2018/07/26/technology/qualcomm-nxp-merger-china/index.html

National Strategies for AI

Many actors attempt to define principles for responsible use of AI



EU HLEG AI
initial work

Founded in 2018 with a group of 52 experts

Reliable AI concept and 7 key requirements

Deliverables:

1. Ethical guidelines for reliable AI
2. Policy and investment recommendations for reliable AI
3. Final evaluation checklist for reliable AI
4. Sectoral Policy Considerations and Investment Recommendations

Constitution of the European AI Alliance Annual Assembly

https://ec.europa.eu/digital-single-market/en/high-level-expert-group-artificial-intelligence

The AI Act: regulatory requirements in Europe
recent strategy

While all AI systems need to satisfy some minimal requirements under the AIA, high-risk AI systems are subject to more scrutiny and accountability.

The EU's approach to artificial intelligence centres on excellence and trust, aiming to boost research and industrial capacity and ensure fundamental rights.

The Commission published its AI package in April 2021, proposing new rules and actions to turn Europe into the global hub for trustworthy AI

The EU will achieve this by:

1. enabling the development and uptake of AI in the EU;
2. making the EU the place where AI thrives from the lab to the market;
3. ensuring that AI works for people and is a force for good in society;
4. building strategic leadership in high-impact sectors.

https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

MISE - National Strategy for Artificial Intelligence
initial work

Launched in 2018 with a group of 30 national experts from different sectors

1. Strengthen the ecosystem of research and innovation in the field of AI
2. Support the adoption of AI-based digital technologies
3. Strengthen the educational offer at every level to bring AI to the service of the workforce
4. Harnessing the potential of the data economy, a real fuel for AI
5. Consolidate the regulatory and ethical framework that governs the development of AI
6. Promote awareness and trust in AI among citizens
7. Re-launch the public administration and make public policies more efficient
8. Promote European and international cooperation for responsible and inclusive AI

https://www.mise.gov.it/images/stories/documenti/Strategia-Nazionale-Intelligenza-Artificiale-Bozza-Consultazione.pdf

MISE - National Strategy for Artificial Intelligence
recent strategy

In november 2021 Italy launches the national strategy for Artificial Intelligence, called «*Strategic Programme on Artificial Intelligence*»

Twenty-four policies to accelerate innovation and the potential of AI in the country's economic and social fabric over the next three years.

Inspired by five guiding principles

1. Italy’s AI is a European AI, in line with the EU coordinated Plan on Artificial Intelligence
2. Italy will be a global research and innovation hub of AI
3. Italy’s AI will be human-centered, trustworthy and sustainable
4. Italy companies will become leaders of AI-based reseach, development and innovation
5. Italy’s public administration will govern with AI and will govern AI

https://innovazione.gov.it/notizie/articoli/intelligenza-artificiale-l-italia-lancia-la-strategia-nazionale/
https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence-2021-review

New ethical codes

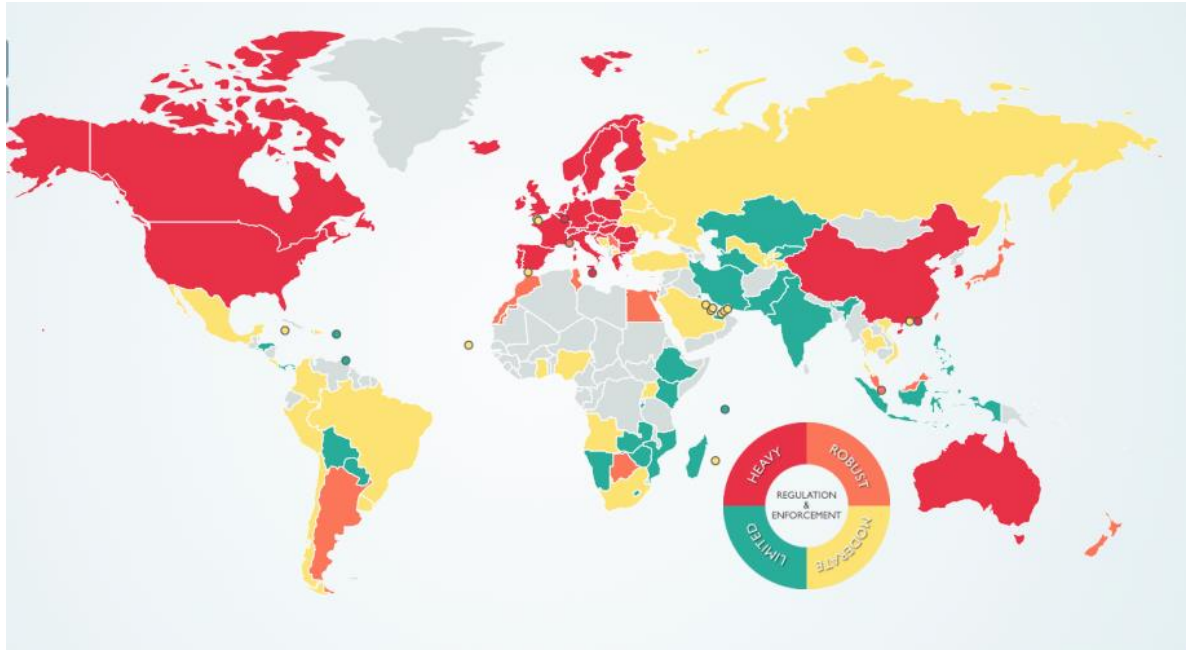
Two of the major AI conferences adopt new ethical codes

- NeurIPS and ICLR both propose new ethical principles and researchers' expectations
- NeurIPS will create a dedicated team of reviewers with experience in machine learning and ethics
- NeurIPS now requires authors "to include a statement of the potential wider impact of their work, including its ethical aspects and future social consequences"
- Given the increased role of companies like Facebook and Google at NeurIPS "Authors are required to provide explicit disclosure of funding ... and competing interests"
- NeurIPS “strongly encourages” the sharing of data and models, but moves away from the obligation. In this respect, ML is at the heart of leaders in life sciences, such as the Wellcome Trust or Nature. Example: "A condition for publication in a Nature Research journal is that authors are required to make readily available to readers associated materials, data, code and protocols without undue qualification."

Source: https://iclr.cc/public/CodeOfEthics
Source: https://nips.cc/Conferences/2020/CallForPapers
Source: https://venturebeat.com/2020/02/24/neurips-requires-ai-researchers-to-account-for-societal-impact-and-financial-conflicts-of-interest/
Source: https://www.nature.com/nature-research/editorial-policies/reporting-standards

Data Protection

- EU: General Data Protection Regulation (EU 2016/679, 25/05/2018)
- China: The Data Security Law or *Personal Information Protection Law (end of 2021)*
- India: *Personal Data Protection Bill*
- USA: Hundreds of "privacy and data security" among the states. The Algorithmic Accountability Act was proposed, and ignored, in 2019. Since then, the US hasn't seen any attempt at a comprehensive national AI regulation or consumer data privacy law → **will they unify?**



https://www.dlapiperdataprotection.com/index.html?t=world-map&c=US&c2=IT

Impacts of AI and ML

"The term Green AI refers to AI research that produces new results without increasing computational costs and, ideally, reducing them."

OpenAI, AllenAI Institute …

CO2 consumption for training NLP algorithms

Consumption	CO_2e (lbs)
Air travel, 1 passenger, NY↔SF	1984
Human life, avg, 1 year	11,023
American life, avg, 1 year	36,156
Car, avg incl. fuel, 1 lifetime	126,000
Training one model (GPU)	
NLP pipeline (parsing, SRL)	39
w/ tuning & experimentation	78,468
Transformer (big)	192
w/ neural architecture search	626,155

"Energy and Policy Considerations for Deep Learning in NLP", ACL2019
https://blog.google/products/search/search-language-understanding-bert/

Impacts of AI and ML

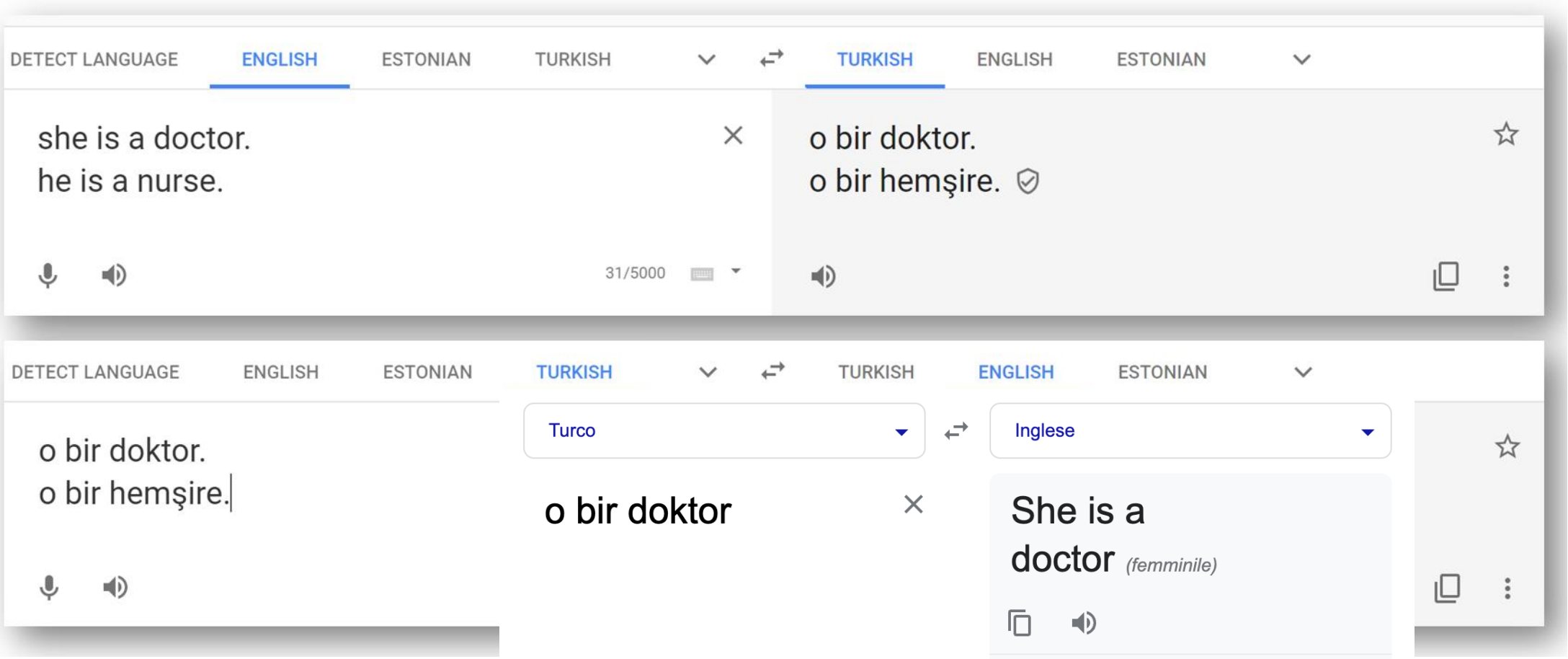
AI algorithms rely on data to learn tasks

The data is produced by users and can be biased or biased towards certain political or racial orientations

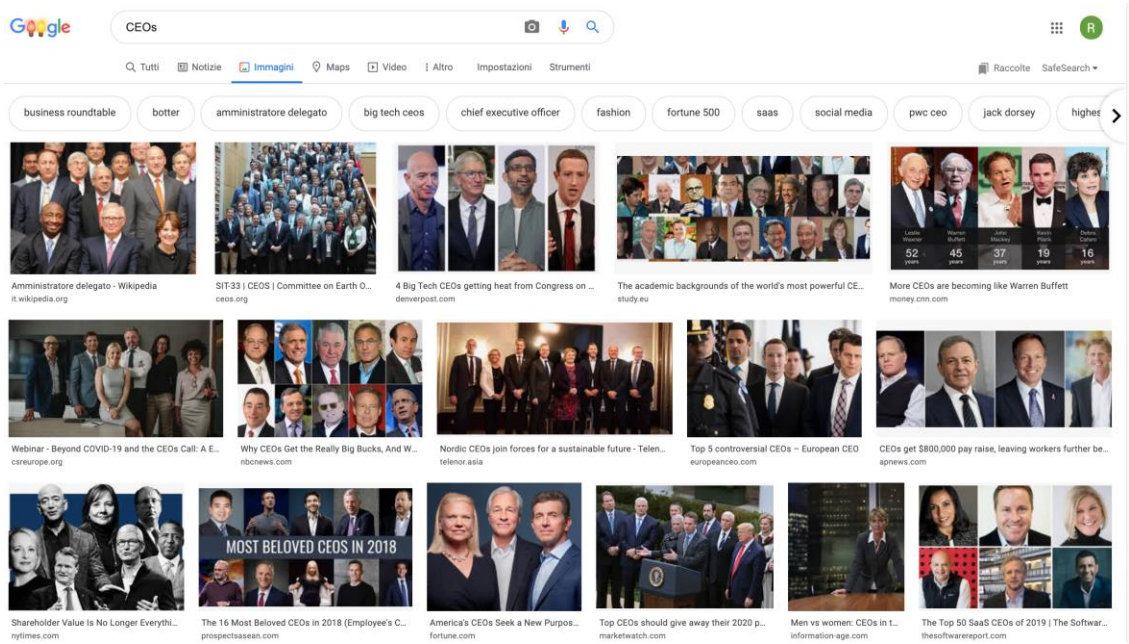
Some examples:

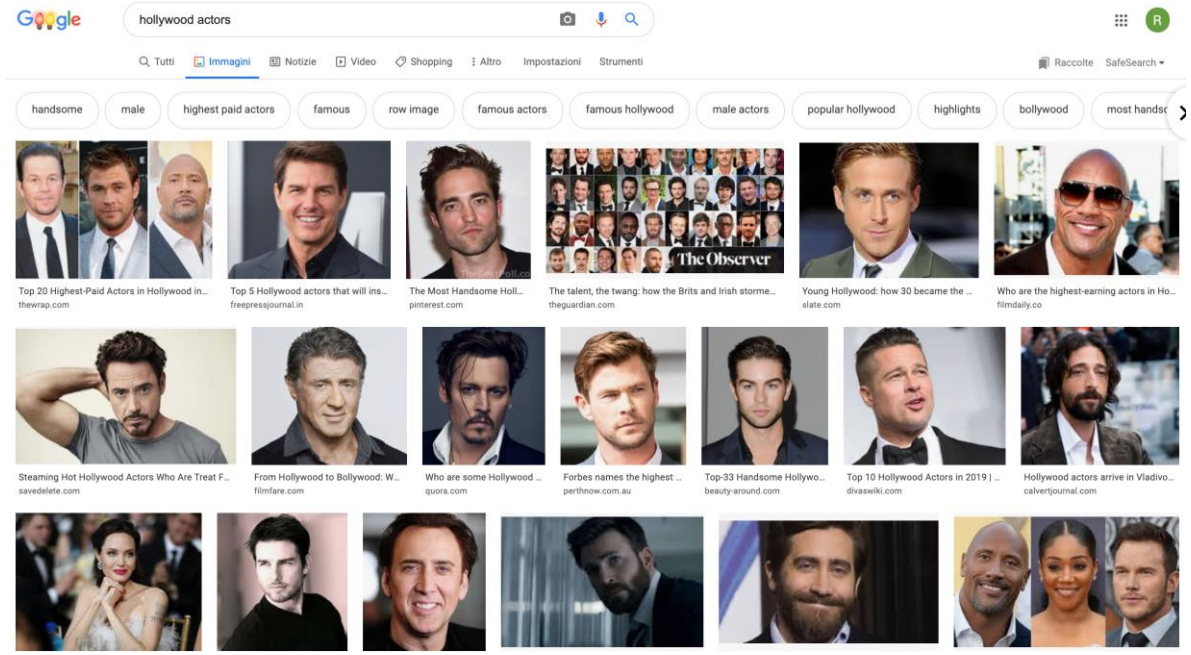
The algorithm for predicting future crimes showed a bias towards black people, assigning them a higher probability of risk

Bias


DETECT LANGUAGE
ENGLISH
ESTONIAN
TURKISH
she is a doctor.
he is a nurse.
31/5000
TURKISH
ENGLISH
ESTONIAN
o bir doktor.
o bir hemşire.
DETECT LANGUAGE
ENGLISH
ESTONIAN
TURKISH
o bir doktor.
o bir hemşire.
TURKISH
ENGLISH
ESTONIAN
Turco
Inglese
o bir doktor
She is a doctor (femminile)
He is a doctor (maschile)

Bias


CEOs
Tutti
Notizie
Immagini
Maps
Video
Altro
Impostazioni
Strumenti
Raccolte
SafeSearch
business roundtable
botter
amministratore delegato
big tech ceos
chief executive officer
fashion
fortune 500
saas
social media
pwc ceo
jack dorsey
MOST BELOVED CEOS IN 2018


hollywood actors
Tutti
Immagini
Notizie
Video
Shopping
Altro
Impostazioni
Strumenti
Raccolte
SafeSearch
handsome
male
highest paid actors
famous
row image
famous actors
famous hollywood
male actors
popular hollywood
highlights
bollywood
The Observer

Bias

WIRED BACKCHANNEL BUSINESS CULTURE GEAR IDEAS SCIENCE MORE SIGN IN SUBSCRIBE

TOM SIMONITE BUSINESS 01.11.2018 07:00 AM

When It Comes to Gorillas, Google Photos Remains Blind

Google promised a fix after its photo-categorization software labeled black people as gorillas in 2015. More than two years later, it hasn't found one.

Google Is Sorry its Sentiment Analyzer is Biased

The company's Cloud Natural Language API rated being a Jew or homosexual as negative.

By Louise Matsakis

October 25, 2017, 10:36pm Share Tweet Snap

MORE LIKE THIS

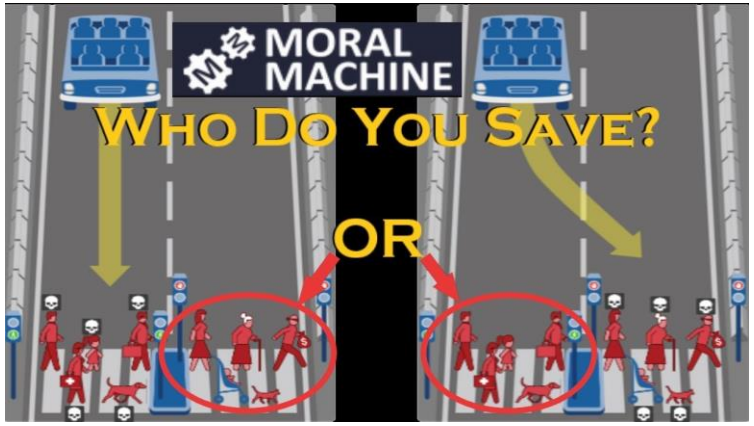
Tech

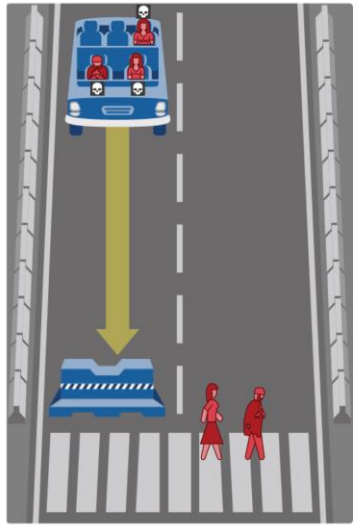
How Government AI Stole Hundreds of Millions of Dollars From Citizens

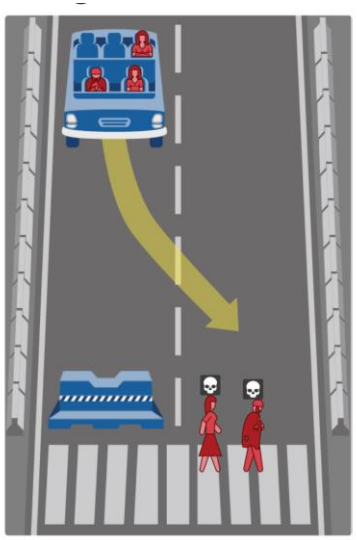
BEN MAKUCH

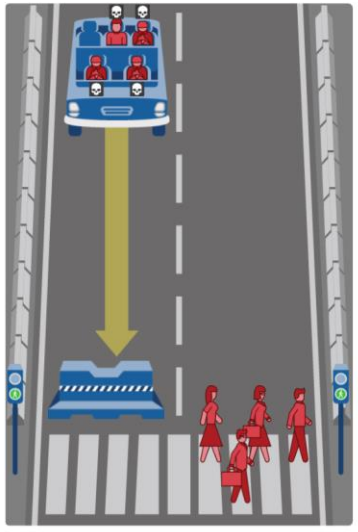
09.03.20

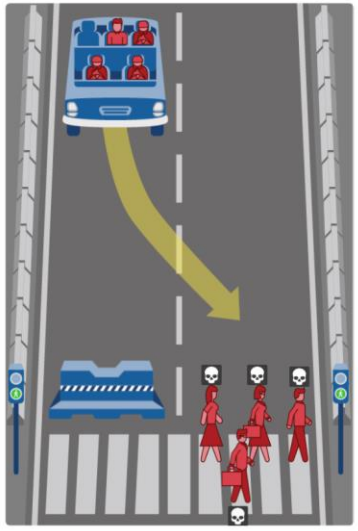
How to choose what to do?

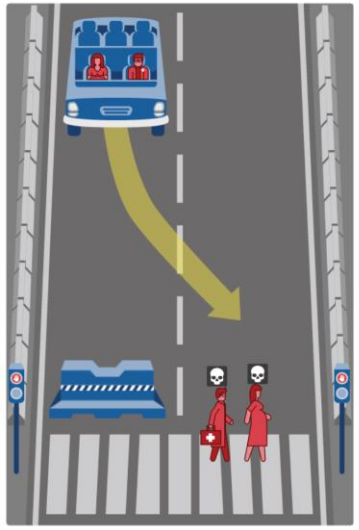


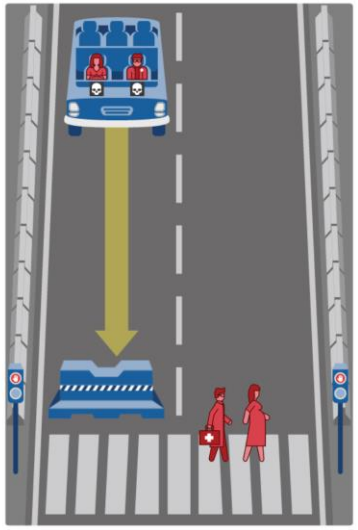












https://www.moralmachine.net

AIW strategic path
Where we go

Mission

We leverage on proprietary composite AI technologies and big data core skills to address vertical business needs, deep diving information, simplifing any human to machine interaction, in complex environments

Execution

- Vision uniqueness
- Talented people (passion, pragmatism, urgently)
- Technologies excellence
  - Solid organic growth (resilient, responsible)
  - M&A strategy acceleration

Target 2024

AIW

Leader

European listed vertical AI player

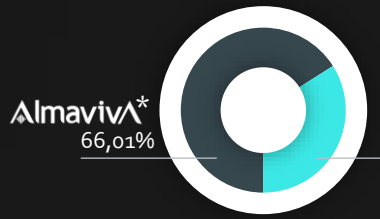
Almawave at glance 2022 **

First sustainability report 2020

Countries	Clients	Tech Labs
28	>250	5

Branches	People	Partners	Products
18	326	>25	19

AIW.MI
IT0005434615



ALMAWAVE | ALMAWAVE do Brasil | ALMAWAVE USA | PerVoice | abda OBDA SYSTEMS | THE DATA APPEAL COMPANY | sister **

* Last update on June 7th 2022
** The figures do not include Sister acquisition

Our path since IPO

Consistent delivery of our program

March 2021

IPO Almawave at **Euronext Market Growth Milan**

2021 Mid term
H1 Results

Delivered Organic Growth

+21.3%
Revenues

January 2022
FY 2021 Results

Organic Growth with higher profitability and increasing visibility

+23.1%
Revenues

27.2%
EBTDA Adj margin

101M
Backlog*

April 2022

The Data Appeal Company finalized
(100% stake)

Highlights Q1

Continuous Growth with higher profitability

+30.8%
Revenues

25.1%
EBTDA Adj margin

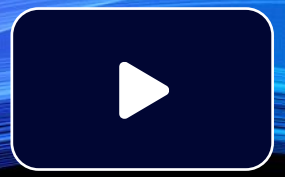
May 2022

Sister acquisition finalized
(100% stake)

* Including multi-year contracts and weighted value of general contractual framework agreement

Proposition
Towards vertical disruption


AI 4 field management


AI 4 transparency


AI 4 eHealth


AI 4 justice

+30 Vertical AI Solutions and products

Leveraging on composite AI applications, providing clear answers to specific business needs

- Public Finance & Welfare — sister
- Central Government
- Defense, Security — NEW
- Smart territory — sister
- Healthcare — NEW
- Smart Mobility & Transportation — THE DATA APPEAL COMPANY
- Esterprise, fintech, telco & media — THE DATA APPEAL COMPANY
- Tourism ecosystem — THE DATA APPEAL COMPANY — NEW
- Utilities, green transiction, sustainability — sister — NEW

NEW Launched 2021 NEW Launch 2022

Proposition
Exploiting the AI potential

TECHNOLOGIES*

NLP | ASR | Knowledge graph | Dialogue | Omnichannel | Machine Learning

iride®

Audioma®

mastro

*proprietary technologies

PRODUCTS

+10 Information Governance

+9 Natural Interaction

+35 Languages

sister | THE DATA APPEAL COMPANY

PLATFORMS

NEW

LAUNCHING END OF MARCH

AIdeaMW

THE DATA APPEAL COMPANY

\+

DATA SERVICES

- Big Data
- Open Data
- Data governance
- Data science

sister

Proposition

The new wave of easy AI

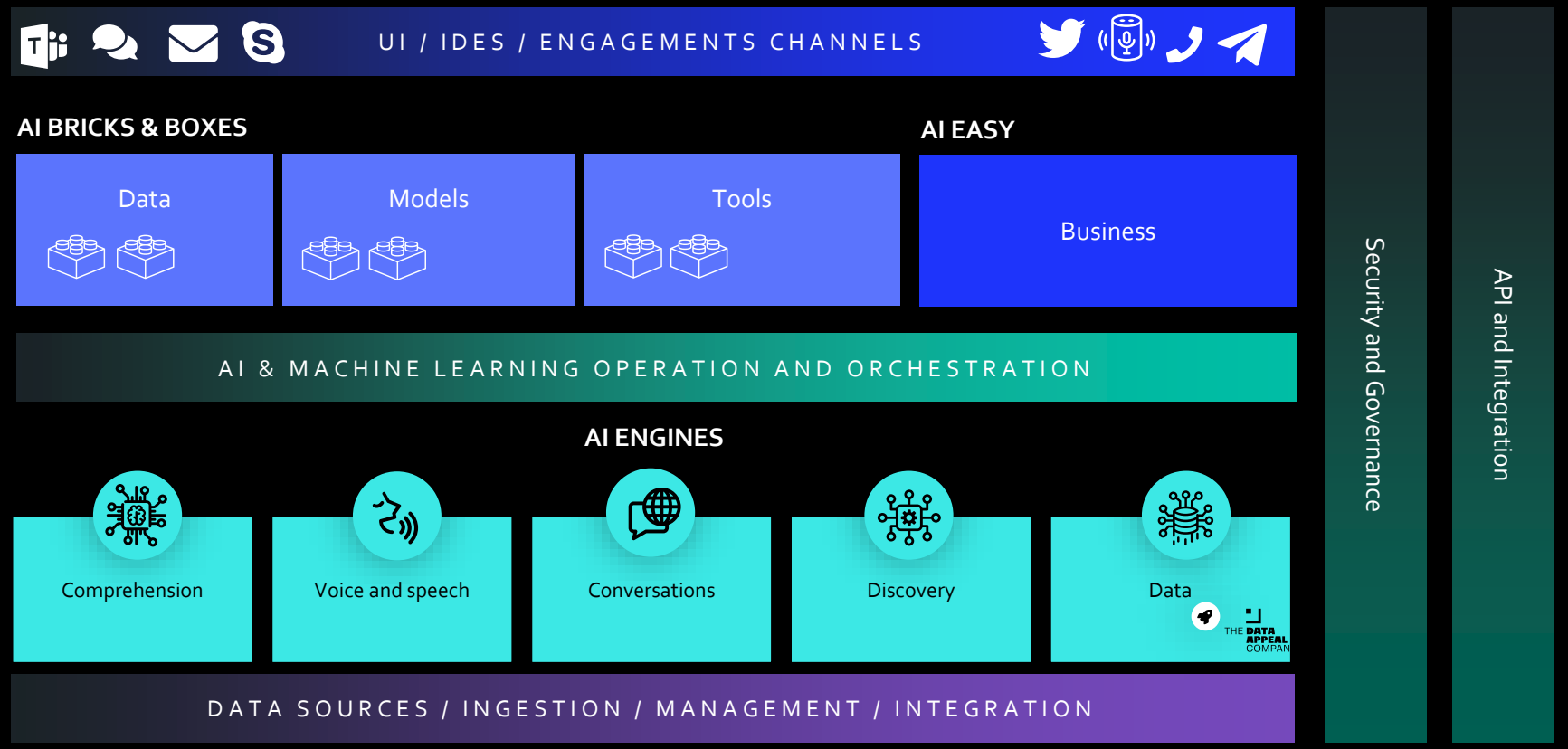
Clients / Partners / Prof. Services

AI EASY

Ready to use AI apps for business users with pre-trained models

AI BRICKS

Bundled technologies, tools, model, capabilities for development and integration of AI applications



Proposition

Moving to the AI "Blue Ocean"

R&D

KPIs of our technology core

R&D ENGINEERS
IN DEDICATED TECH LABS

75

ALMAWAVE PerVoice
OBDA SYSTEMS
THE DATA APPEAL COMPANY

STRONG R&D FOCUS CONFIRMED BY THE CONSIDERABLE AMOUNT OF CAPEX

>35M€
SINCE 2010

15.5% 2021 Total Revenues

TECHNOLOGY MARKET ANALYSTS REPORTS

>65

ACADEMIC PARTNERS
IN A WIDE NETWORK

10s

UNIVERSITY SPIN-OFFS

2

OBDA SYSTEMS
SAPIENZA
SPIN DATA
FEDERICO II

MAIN PLATFORMS

iride®
mastro
Audioma®
AI
THE DATA APPEAL COMPANY

US PATENTS + PCTO TO EU AND LATAM

3

RESEARCH PROJECTS
(NEW PROJECTS PENDING)

11

TECHNOLOGY HIGHLIGHTS

- Multi-level & Multi Class Automatic Text Categorization
- Knowledge Discovery and Semantic Insight Engine
- Speech & Text Conversation Analytics
- Conversational Assistants and Dialog Management
- Sentiment and Emotion Analysis
- Virtual Enterprise Knowledge Graphs
- Graph Analysis and Navigation
- Entity Disambiguation and Linking
- Relation Extraction
- Spoken Machine Translation
- Speaker Identification
- Voice Biometrics
- Morphing & Anonymization

KEY RESEARCH TOPICS

- Explainable AI and Interpretability
- Trustworthy AI
- Federated Learning & Differential Privacy
- Recommenders and Active Learning
- Continuous Learning
- Transfer Learning

Digital Transformation in Health Care

RicovAI

AI benefits for eHealth

IMPLEMENT PERSONALIZED MEDICINE

TRANSFORM DIAGNOSTIC SUPPORT IN SUPPORT TO PROGNOSTIC

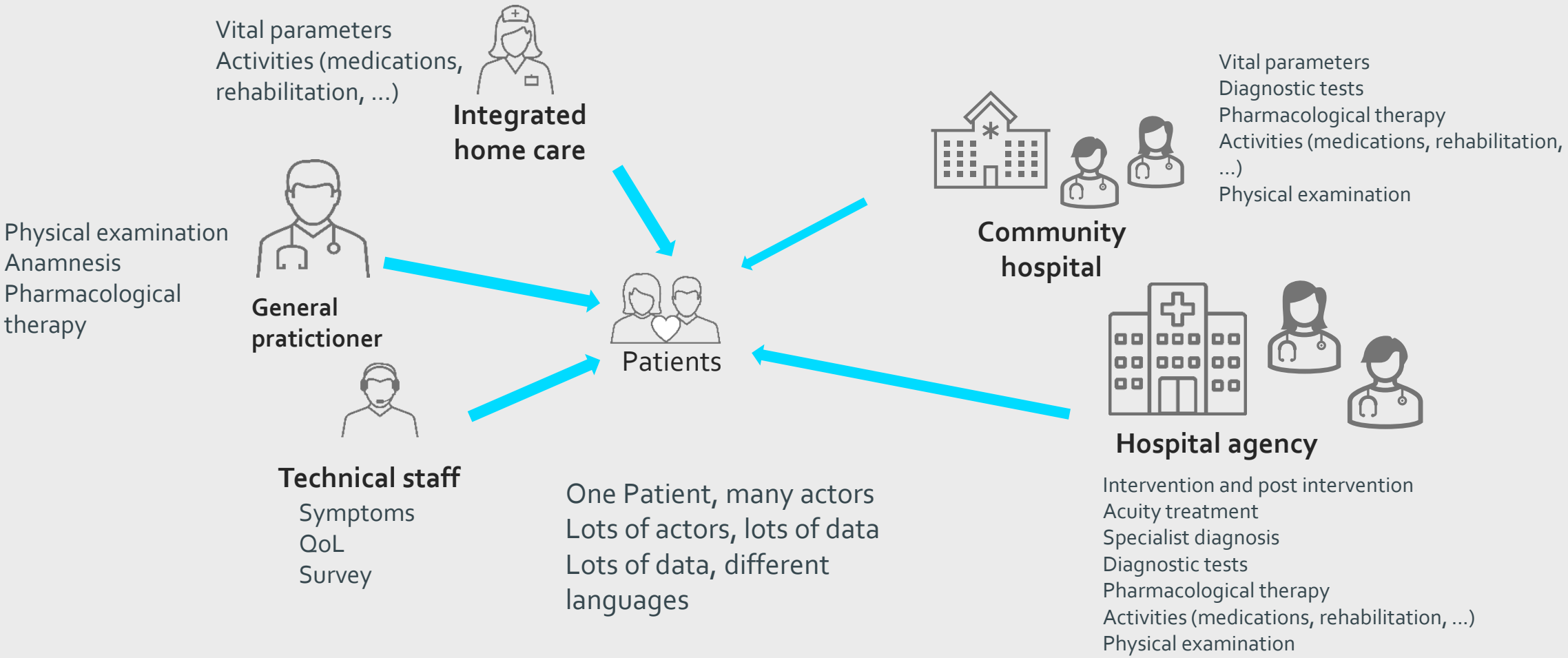
ALLOW THE ONE TO MANY

(1 DOCTOR MANY PATIENTS)

ACHIEVE HOSPITAL – TERRITORY INTEGRATION

RicovAI

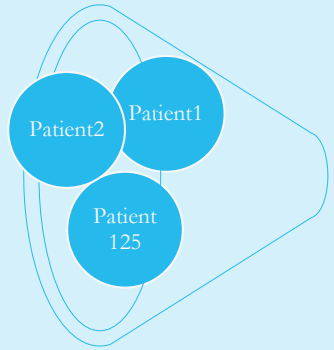
Artificial Intelligence to understand all the stakeholders



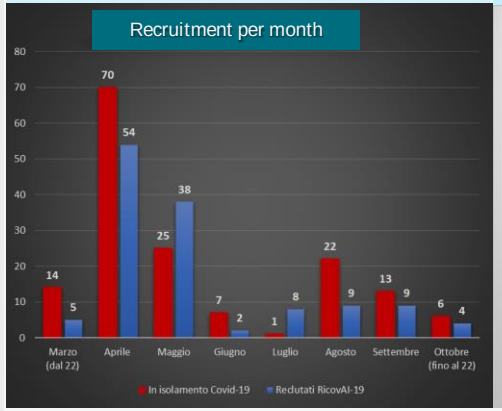
RicovAI

The project

Recruitment

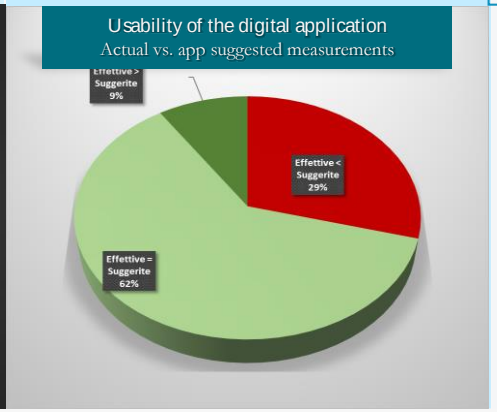


Objective: Adherence to the digital application> 20-40%

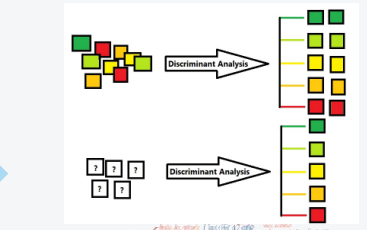


APP Usability

Objective: Usability (average) of the digital application> 60%



AI model trained



Objective: Clinically observed CSI values> 95%

---

129 Recruited
7.386 annotations
57 surveys per recruited
On average 3 surveys per day

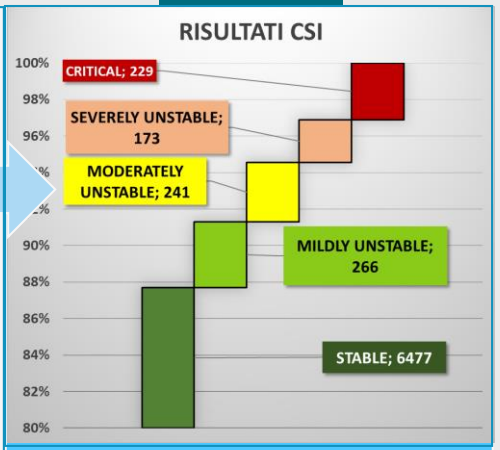
---

9 cases (0.1%) with expected CSI <> RicovAi-19 result.

---

7 new info (3 discriminants)

Outcome



Objective: at least 200 observations per CSI cluster

Objective: (average) satisfaction with the digital application> 60%

From clinical investigation to a multipathology product

Ethics committee approved

Clinical trial

Test results ➔ OK

Medical Device Certification
according to MDR

Diagnostic and prognostic Product
DevAIce

DevAIce Product

- Single and scalable platform for pathology
- Care driver: Clinical stability index
  (1 for pathology)

ASST Vimercate

PREDICTIVE SOLUTIONS FOR CLINICAL PERSONNEL

The realization of an Artificial Intelligence & Big Data architecture, feed by clinical IT assets, allows to develop a plethora of decision support system solutions for doctors and IT for managing ordinary administrative processes

MODELS AND DATA SOURCES FOR IMPROVING PROCESSES

Models are based on a variety of data sources, such as blood analysis, comorbidity, recovery, access to first aid, imaging, sensor's data and pharmacotherapy.

SOURCES
Medical records
Pharmacological Therapies
Register
Booking system
Laboratory

MACRO ASPECTS RELATED TO ARTIFICIAL INTELLIGENCE

Macro aspects that can be realized with artificial intelligence techniques are:

CLASSIFICATION OF CHRONIC DISEASES

PREDICTION OF TRENDS AND/OR COMPLICATIONS OF CHRONIC DISEASES

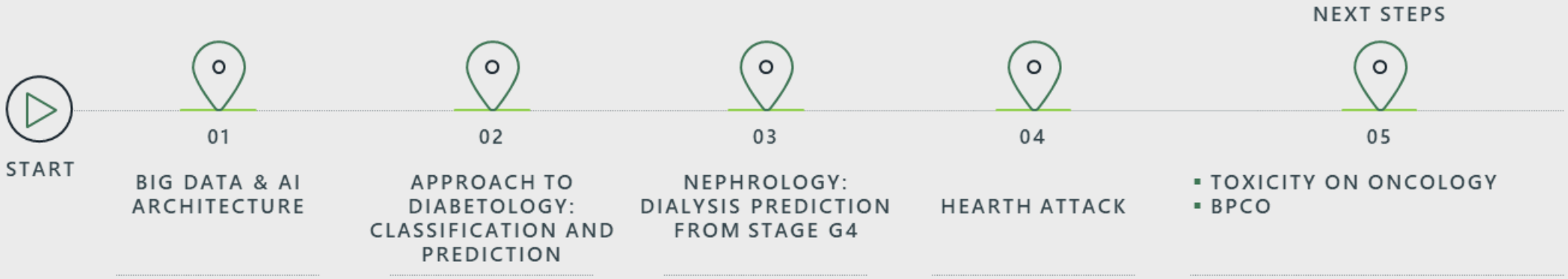
OPTIMIZATION OF LOGISTICS

ASST Vimercate

AGILE APPROACH

The solution has been incrementally designed with the help of clinical staff for fulfilling the required needs.

For every case, a feasibility study has been conducted for selecting the most effective features.



ASST Vimercate

USE CASE

DIABETES & COMPLICATION

RESULTS

USE CASE	TARGET	METHOD	DESCRIPTION
Diabetic / Healty	Classification	CNN+MLP	Model for classifying whether a patient is healthy, or he/she has diabetes.
Diabetic / Healty / Pre-diabetic	Classification	CNN+MLP	Model for classifying whether a patient is healthy, or he/she has diabetes or in a pre-diabetic stage.
4 types of diabete complications	Prediction (up to 3 years)	Random Forest	Model for predicting complications on **kidney**, **hearth**, **eyes** and **blood vessels** on diabetic patients up to 3 years.

Use case	Target	Method	Precision	Accuracy	Recall
Diabetic / Healthy	Classification	CNN	97 %	98 %	96 %
Diabetic / Pre-Diabetic / Healthy	Classification	CNN + MLP	90 %	96 %	86 %
Diabete complications on hearth	Prediction (up to 3 years)	Random Forest	88 %	90 %	84 %
Diabete complications on kidney	Prediction (up to 3 years)	Random Forest	88 %	91 %	87 %
Diabete complications on blood vessels	Prediction (up to 3 years)	Random Forest	89 %	98 %	85 %
Diabete complications on eyes	Prediction (up to 3 years)	Random Forest	86 %	84 %	81 %

ASST Vimercate

USE CASE

DIALYSIS & HEART FAILURE

RESULTS

USE CASE	TARGET	METHOD	DESCRIPTION
Dialysis	Prediction	Random Forest	Model for predicting whether a patient would require dialysis treatment when being in stage G4.
Heart Failure	Classification	XG Boost	Model for predicting whether a patient will require a re-hospitalization after being affected by a heart attack.

Use case	Target	Method	Precision	Accuracy	Recall
Dialysis stage G4 before 18 months/after 18 months	Prediction	Random Forest	93 %	93 %	94 %
Dialysis stage G4 before 6 months/between 6 and 18 months/after 18 months	Prediction	Random Forest	92 %	92 %	91 %
Dialysis stage G4 before 18 months/between 18 and 40 months/after 40 months	Prediction	Random Forest	93 %	93 %	93 %
Heart attack: re-hospitalization within 30 days for any cause	Prediction	XG-Boost	86 %	85 %	88 %
Heart attack: re-hospitalization within a year for a second heart attack	Prediction	Random Forest	86 %	84 %	87 %

ASST Vimercate

USE CASE

NEXT STEP

RESULTS

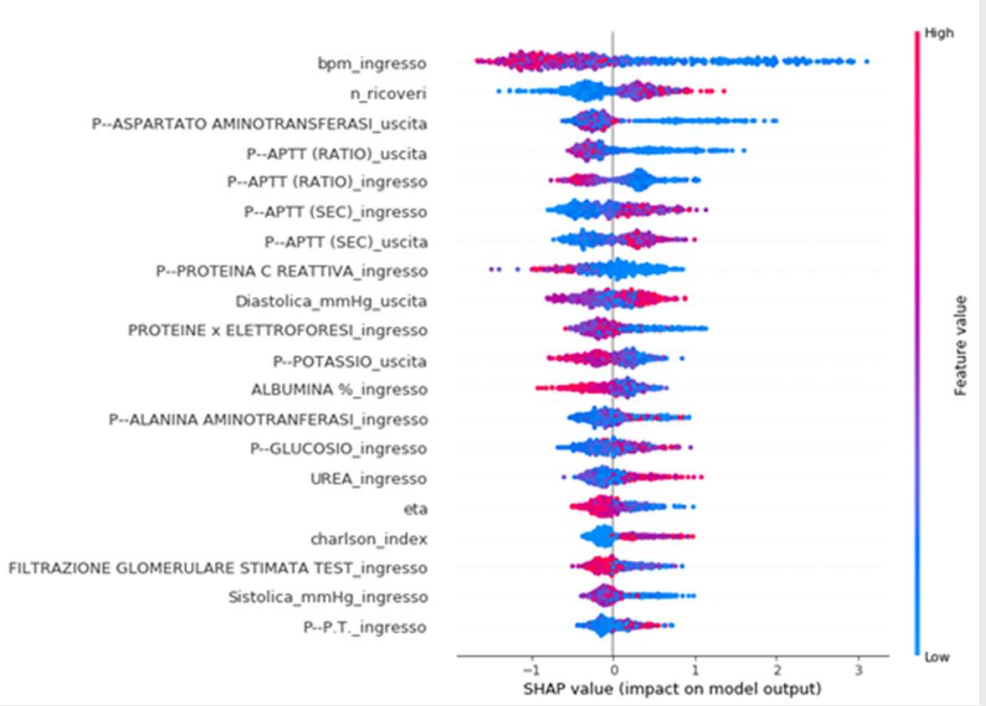
USE CASE	TARGET	METHOD	DESCRIPTION
Toxicity in Oncology	Prediction	XG Boost	Model for predicting the probability that a treatment can generate a toxicity effect on a patient with a cancer.
BPCO	Prediction	Random Forest	Model for predicting possible complications on patients having BPCO

BEYOND A BLACK BOX

On the left, the parameters has been ranked based on their importance (i.e., bpm_ingresso is more important than eta).

By using a different scale of colors, we are able to understand for which range of values a parameter is key.

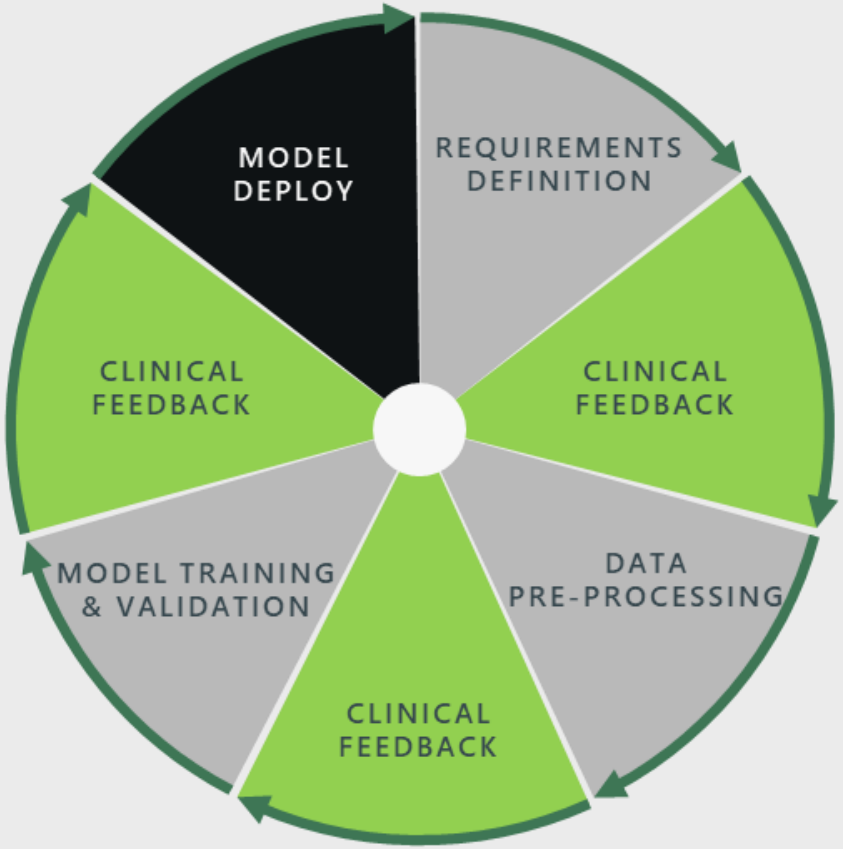
Let us consider n_ricoveri, the XAI algorithm is telling that the higher the value is, the most likely is to be having the patient in a critical situation, and this makes sense.



ASST Vimercate

ROLE OF MEDICAL PERSONNEL IS THE KEY

A **doctor** plays an **active role** allowing Data Scientists to correctly understand medical data and to take the right decisions when performing **data selection, data engineering** and **model validation**.



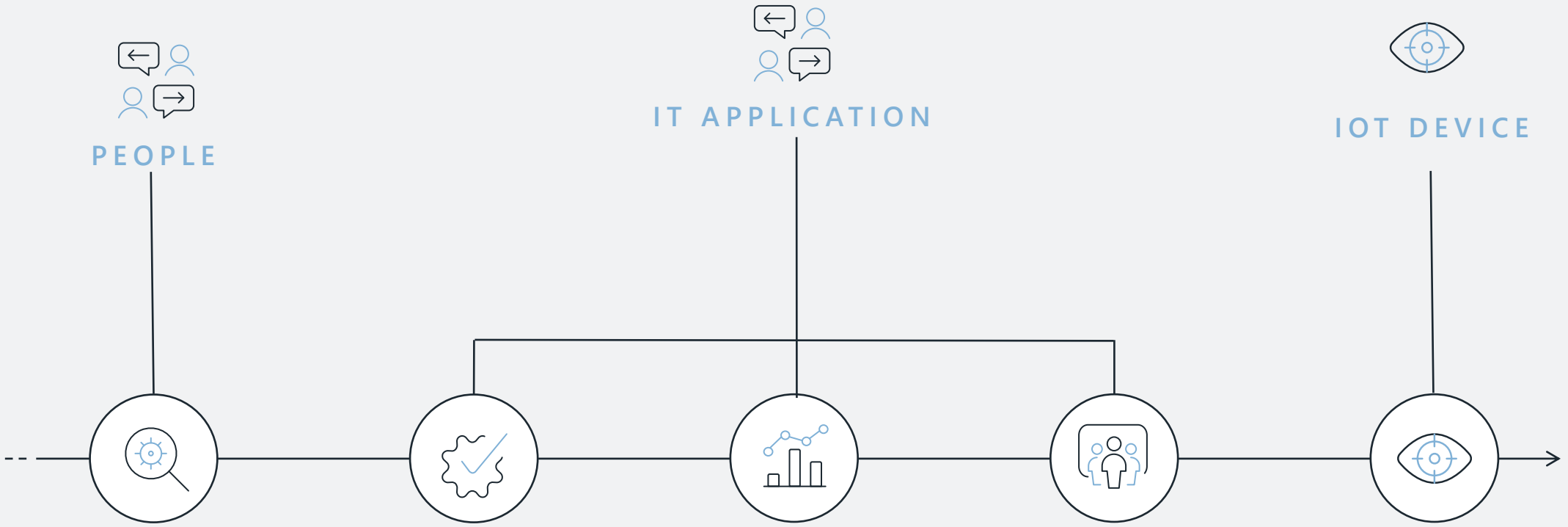
What hypothesis should we made?
How features should be chosen?

How trained model will be used?
What is the meaning of results?

Who is going to use the model?
How the model will be used?

Smart City

Smart City Ecosystem: More, complex and Different Data



- Positioning
- Sentiment

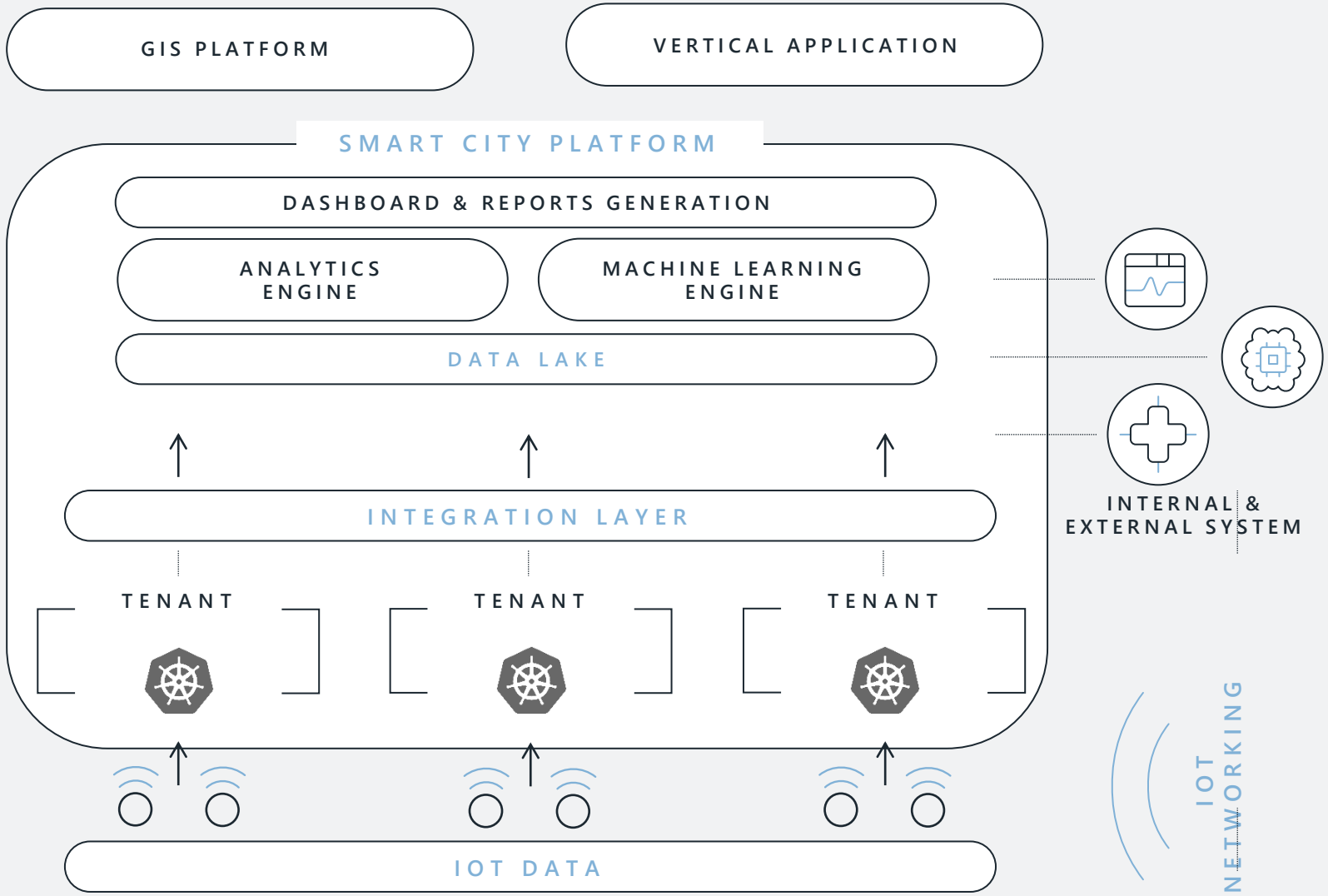
- Data of urban process
- PA Data (ex workflow)

- Smart City Vertical
- Smart Mobility
- Green
- Security

- Events
- Citizen Emergency reports

- TVCC
- Gateway & Sensor
- Satellite Data

Smart City Technology Ecosystem



Vertical Application: That realize a vertical use case, and API pubblication

Control Room: System based on dashboards and GIS with which users' interface for ecosystem management and monitoring purposes

Data Lake & Analytics Layer: for the aggregation and analysis of data also through the use of artificial intelligence

IoT & Integration Layer: for the collection and management of data from both sensors and internal and external information systems

ALMAWAVE

Use Case: Intelligence Video Analytics

- **IMPROVE THE WORK OF PEOPLE**
- **IDENTIFY VIOLATION IN REAL TIME**

- Old generation cameras force staff to watch TVCC continuously
- The Violation are identified better and in real time

PATTERN RECOGNITION & OBJECT DETECTION

Computer Vision & AI for:

- Pattern recognition (ex waste abandonment) to improve city security
- Object Detection (ex people count) to realise a DSS

Use Case: AI & Analytics 4 satellite images analysis

CROP IDENTIFICATION

Identification of crops in order to **detect any anomalies between the declared crop and the real**

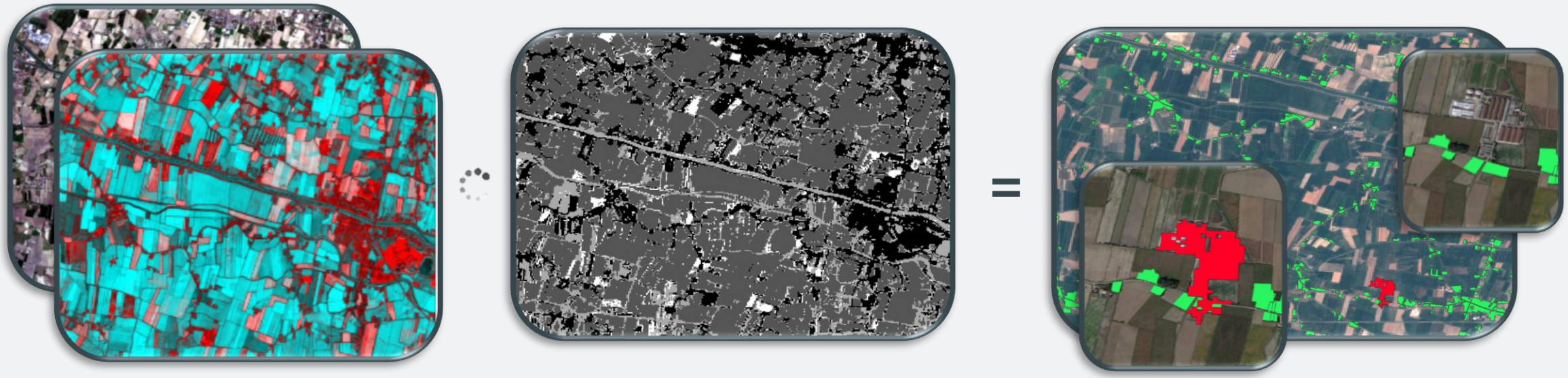
BUILDING IDENTIFICATION

Identification of buildings to verify the possible presence of illegal ones. It is possible **correlating land registry data and satellite images**

PROCESSING SATELLITE DATA

GROUND OBJECT CLASSIFICATION

CHANGE DETECTION – NEW BUILDING



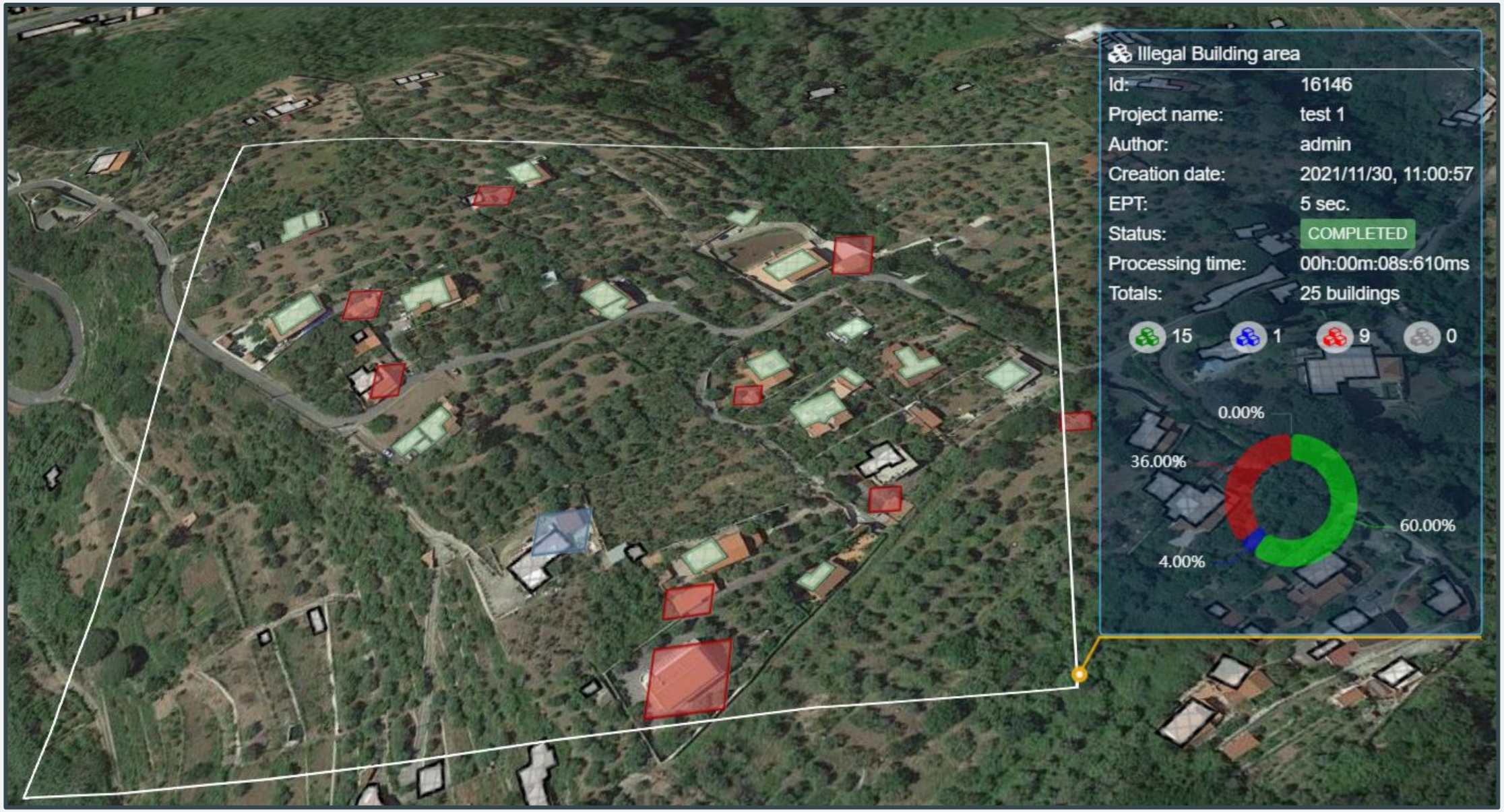
SENTINEL 2

CLASSIFICATION ALGORITHM

TIMELINE SCROLL TO VERIFY NEW BUILDING

ALMAWAVE

Use Case: AI & Analytics 4 satellite images analysis



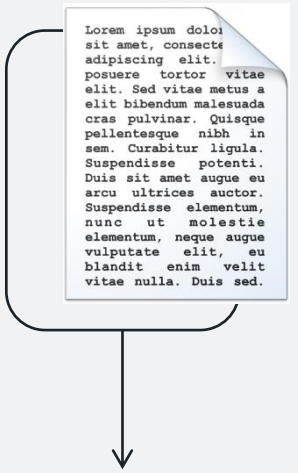
Use Case: AI to support citizen with PA procedure

VIRTUAL ASSISTANT

Customized **virtual assistants (with AI profiling Algorithm) integrated into IT application that support citizens**

AI ALGORITHM THAT PREDICT PA PROCEDURE OUTCOME

Deep Learning model used to predict the outcome of the PA Procedure (example: real time output "OK, KO, Warning" after a request for building work).



Result: OK
Suggestion: incomplete description
Note: insert also

- risanamento: [{ "facciate": None }]
- creano: [{ condizioni: [pericolo, incolumità] }]
- rimozione: [{ intonaco: [lesionato] }]
- tinteggiate: **None**
- ripristinate: **None**

Use Case: City Digital Twin

DSS PLATFORM

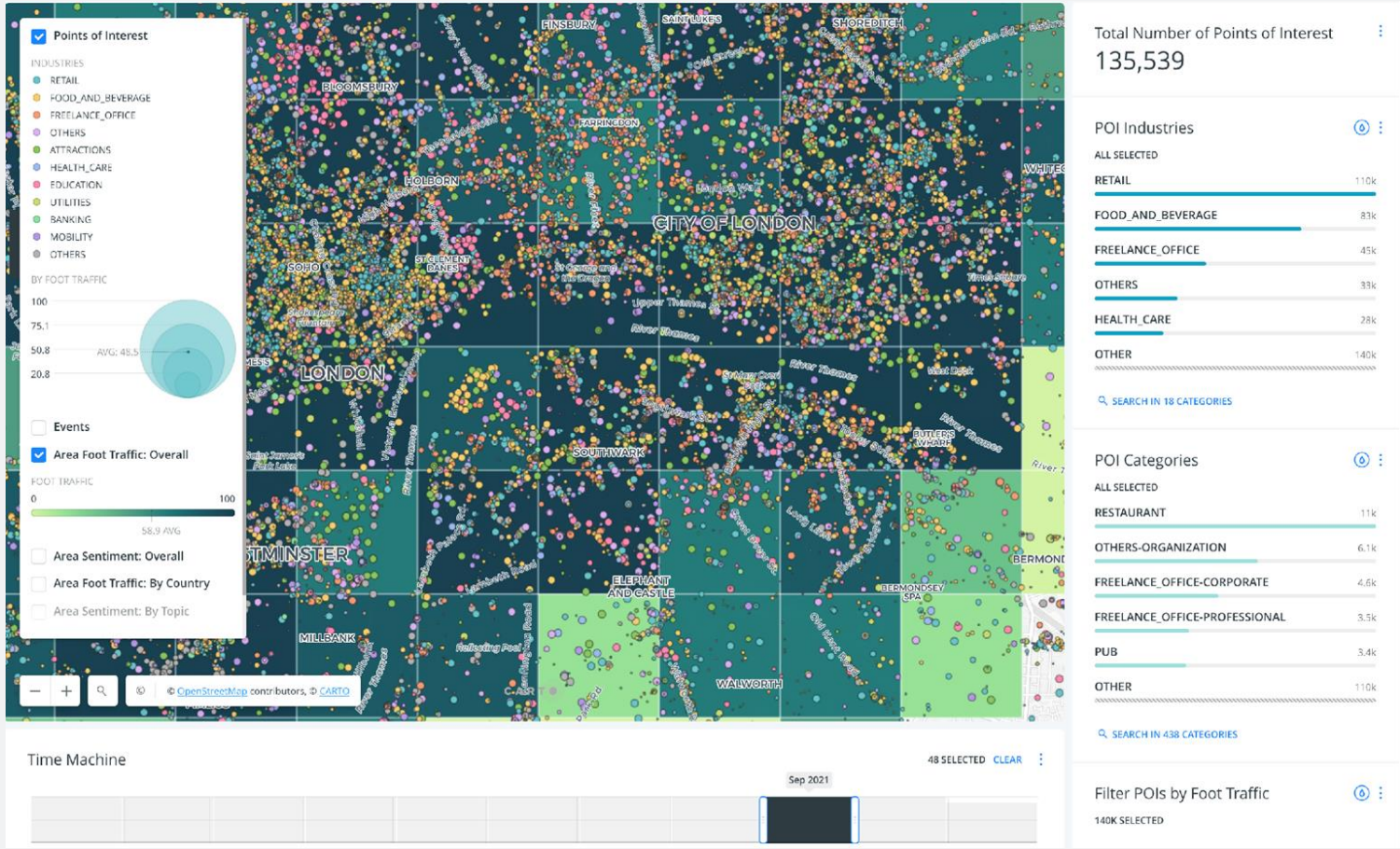
Implementation of a **Decision Support System based on Smart City Index**. Through the DSS system, PAs can both **assess the current state of the city/region** (service coverage, urban safety, citizen sentiment, energy management) and **carry out impact analyses by means of simulations through digital representation of the city** (Digital Twin).

ENERGY	ENVIRONMENT	GOVERNANCE	PHISICAL INFRASTRUCTURE	QUALITY OF LIFE	MOBILITY	URBAN MGMT	ECONOMY & PRODUCTIVITY
• Public Lighting • Renewable Energies • Smart Grid • Home Energy Management	• Air quality • Climate resilience • Ecosystem	• Equity and social inclusion • Community involvement • Organization	• Network and access • Connection to services – electricity • Connection to services – transport • Sewage system management using ICT	• Attractiveness & competitiveness • Public Safety • Human Capital • Access to (other) services	• Mobility Services	• Waste Management • Water Management • Buildings • Urban local and agricultural food security	• Business & Entrepreneurship • Knowledge economy

Use Case: AI 4 identify area potentiality & site selection

DATA DRIVEN IDENTIFICATION OF THE BEST SITES, LOCATIONS, FOR INVESTMENT

- Easily see when points of interest sit in a high-potential or low-potential area.
- Display how the different city areas change over time in terms of performance, foot traffic, and sentiment
- Get the Sentiment and Foot Traffic details about every business in town



Other Use Cases

Use Case 1

Vocal Services «on field»

Solution

Perform and report technical and maintenance activities effectively and accurately, using voice for process automation

Features

- Automatic Speech Recognition and voice transcription
- Intent classification
- Automatic prioritization
- Information Extraction
- Automatic pre-filling of form

Starting from a vocal note…

…the system elaborates and tracks key information

Use Case 2

Social media analysis for gender violence

Solution

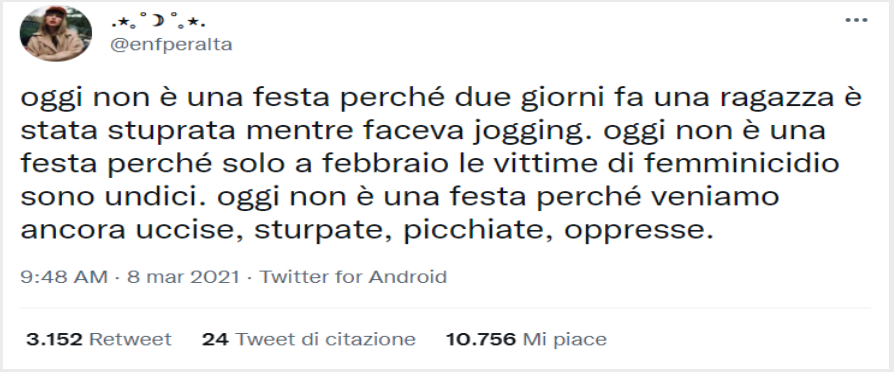
System to support the analysis of social networks, web and press reviews content, collected through the identification of ad hoc keywords to investigate how internet actors talk about the topic Gender Violence

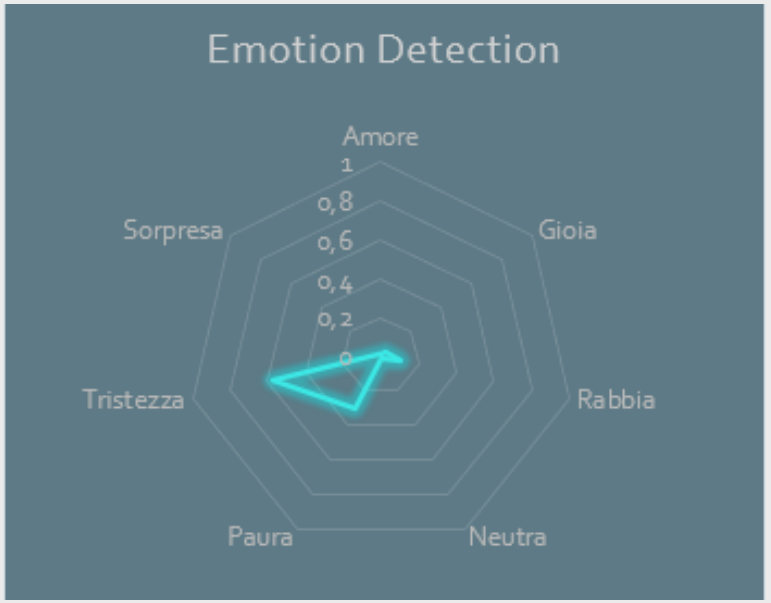
Challenge

- Training of sentiment analysis and emotion detection models in a polarized and specific context
- Identification of keywords suitable for the collection of target content

Features

- Ingestion connectors for collecting target content
- Dashboard for visualizing quantitative and qualitative analysis
- Sentiment Analysis, Emotion Detection e Objectivity detection





Use Case 3

Open Source Intelligence

Solution

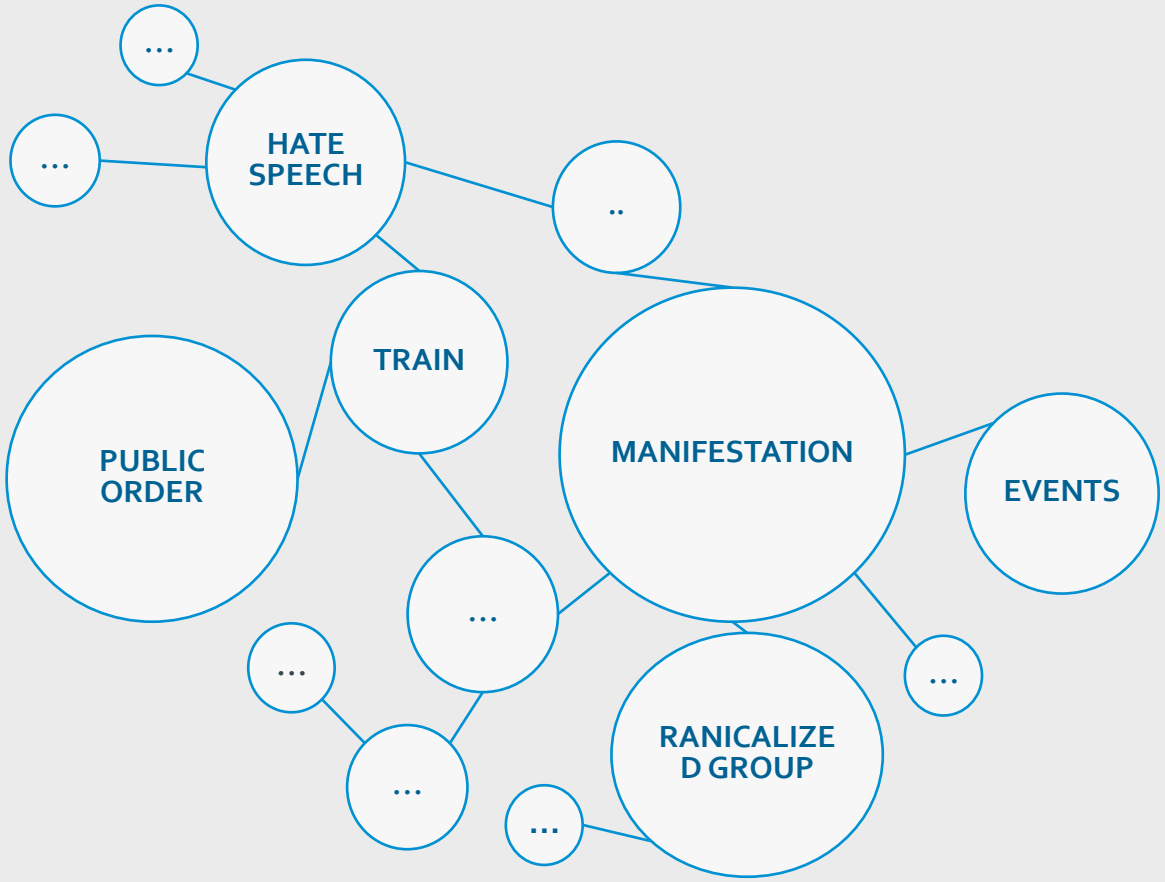
A project aiming to support investigation activities through **Open Source Intelligence - OSINT.**

Challenge

Information Fusion

Features

- Social Media (Twitter, Instagram, Facebook)
- Web Data
- Blog, News, Foto
- Deep & Dark web



Use Case 4

Information extraction & search on "National Recovery and Resilience Plans"

Solution

Analysis support system for multilanguage «National Recovery and Resilience Plans» (NRRP) corpus

Challenge

- Document length and linguistic complexity
- **24 languages** from 27 countries
- **Cross-domain** interoperability

Features

- Semantic search engine enhanced by the EuroVoc thesaurus
- Country scoring algorithm on Euro Area Recommendations (EAR) catalogs

Use Case 5

Speech Analytics

Implement an innovative solution able to extract metrics from contact center phone conversations and using those data points to make informed decisions about your business.

Solution

The aim of the project was to automatically analyze the customer-operator conversation, identifying the semantic concepts of interest, their relations and other important metrics in order to have a 360-degree view of the customers' needs and problems, thus enabling a data driven continuous improvement approach.

Features

- Associate semantic concepts with the correct timeframe in the corresponding audio file
- Identify trending topics and sudden spikes
- Advanced analytics capabilities: clustering, regression, forecasting
- Dashboarding system for a complete view of the Voice of the Customer

Thank you.