

ISTITUTO
ITALIANO DI
TECNOLOGIA

Intelligenza Artificiale, Robotica e Visione Computazionale

Ricerca, prospettive e potenzialità nell'industria 4.0

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Industria 4.0 ?



- Energia Idroelettrica *(fine '700)*
- Elettricità e produzione di massa *(fine '800)*
- Automazione, IT ed elettronica *(fine '900)*
- Information Network *(now!)*

INDUSTRY 4.0

The new industrial revolution
How Europe will succeed

MARCH 2014

Roland Berger
Strategy Consultants

THE FULLY CONNECTED WAY OF MAKING THINGS
Industry 4.0 is based on new and radically changed processes in manufacturing companies: Factory 4.0. In this concept, data is gathered from suppliers, customers and the company itself and evaluated before being linked up with real production. The latter is increasingly using new technologies such as sensors, 3D printing and next-generation robots. The result: production processes are fine-tuned, adjusted or set up differently in real time.



Suppliers

LOGISTICS 4.0
> Fully integrated supply chain
> Interconnected systems
> Perfect coordination

FACTORY 4.0

THINK ACT
INDUSTRY 4.0

CYBER SECURITY
> Stronger protection for Internet-based manufacturing
> Technology products with longer life cycles

CLOUD COMPUTING

BIG DATA
> Making sense out of complexity
> Creativity
> Collaborative manufacturing

SENSORS
> Zero default/deviation
> Reactivity
> Traceability
> Predictability



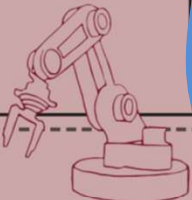
ADVANCED MANUFACTURING SYSTEMS
> Cyber-physical systems (CPS)
- Numerical command
- Full automation
- Totally interconnected systems
- Machine-to-machine communication

**3D PRINTING/
ADDITIVE MANUFACTURING**
> Scrap elimination
> Mass customization
> Rapid prototyping



ADVANCED MATERIALS
> Smart value-added products
> Technical differentiation
> Connectivity

AUTONOMOUS VEHICLE
> Flow optimization
> Increased security
> Lower costs



ROBOT
> Real-time autonomy/productivity
> Full transparency (contextualization, comprehensiveness, collaborative robot) on data reporting

MASS CUSTOMIZATION
> Customer and marketing intimacy
> Flexibility
> Perfect match of customer's needs with mass production efficiency
> On-demand manufacturing



INTERNET OF THINGS
> Object tagging
> Internet-to-object communication via low-power radio
> Real-time data capture
> Optimized stocks
> Reduced waste

Plant of the future

Intelligence

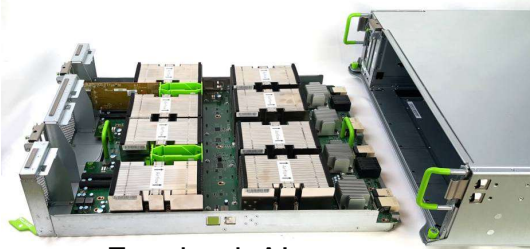
THINK ACT
INDUSTRY 4.0

RESOURCES OF THE FUTURE
(WIND, ALTERNATIVE/
NON-CONVENTIONAL, SOLAR,
GEOTHERMIC)
> Clean and renewable energy everywhere
> Energy storage
> Alternative raw materials

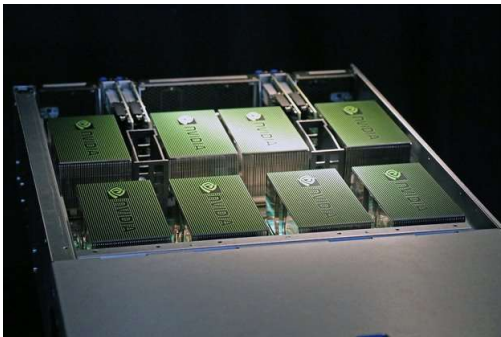
What is Intelligence, NOW

Recent **breakthroughs in machine learning** are driven by revamped research and developments in Neural Networks.

Computing Power!



Facebook AI server

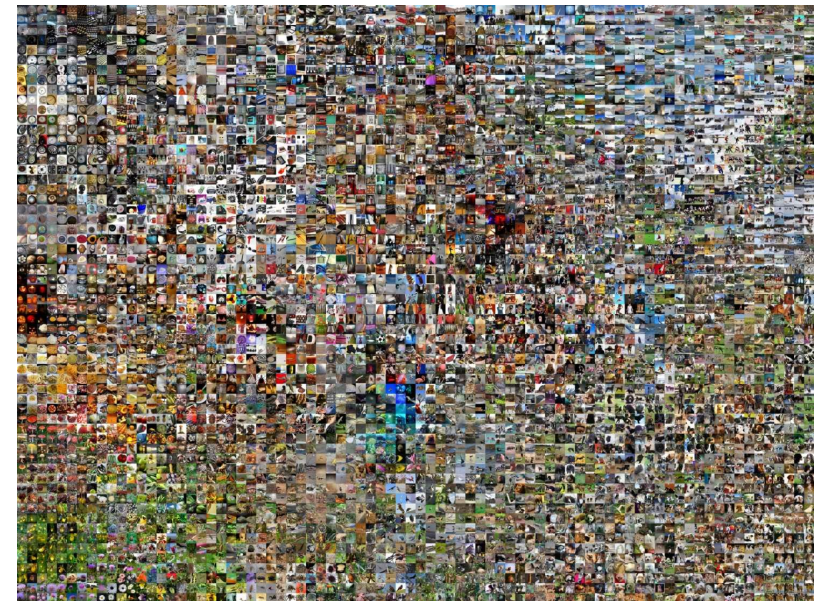


NVIDIA DGX1 Architecture



AND

Data!

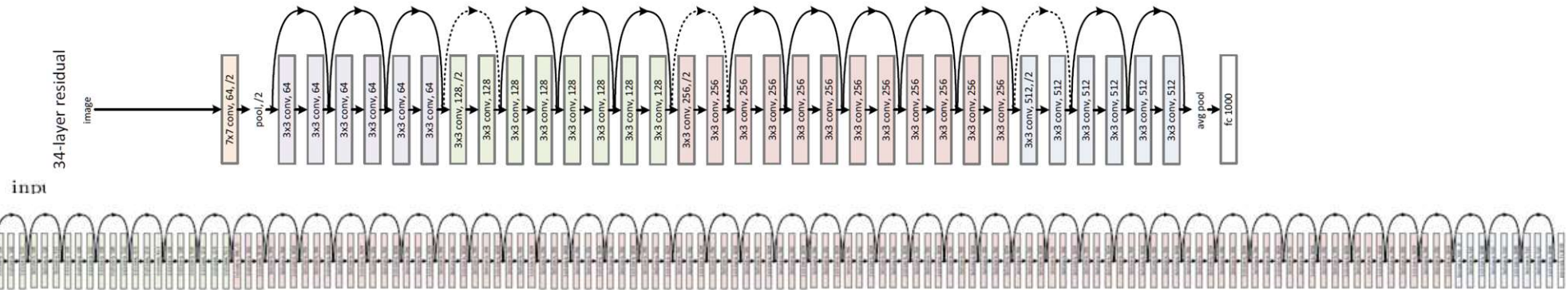


Imagenet dataset (14 million annotated images)

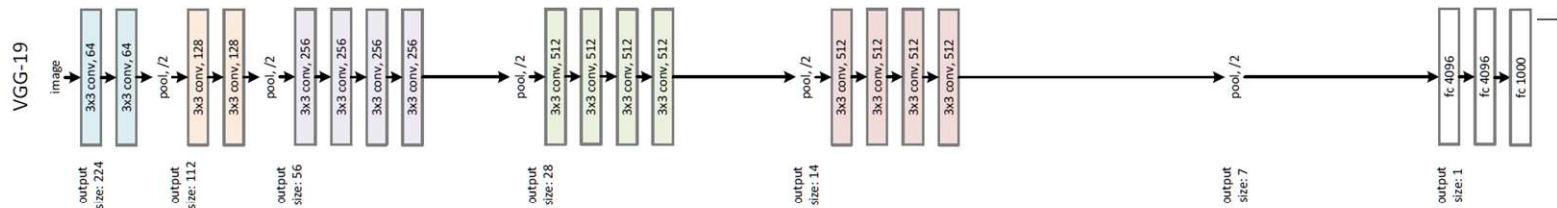
From shallow to deep...

This computational and data shift makes neural networks to work, for two reasons:

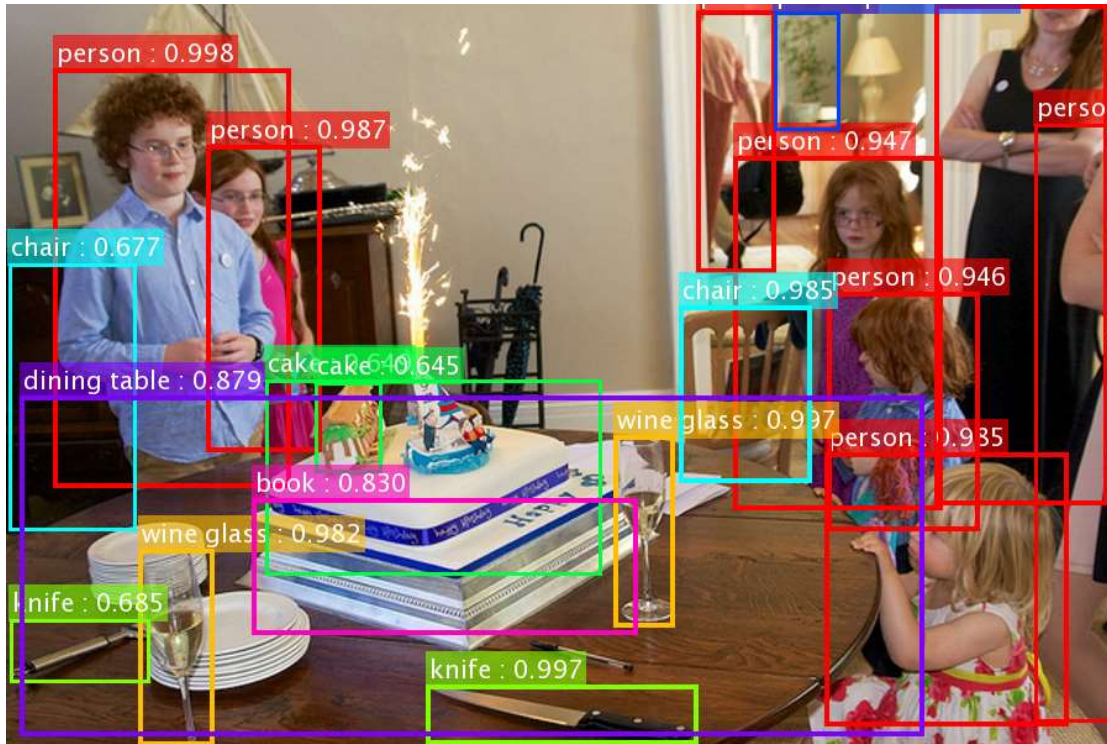
- Massive data, more chances to create a “good” representation of the data for different tasks
- Large scale computation, possibility to design deep networks that can be trained in a “reasonable time”



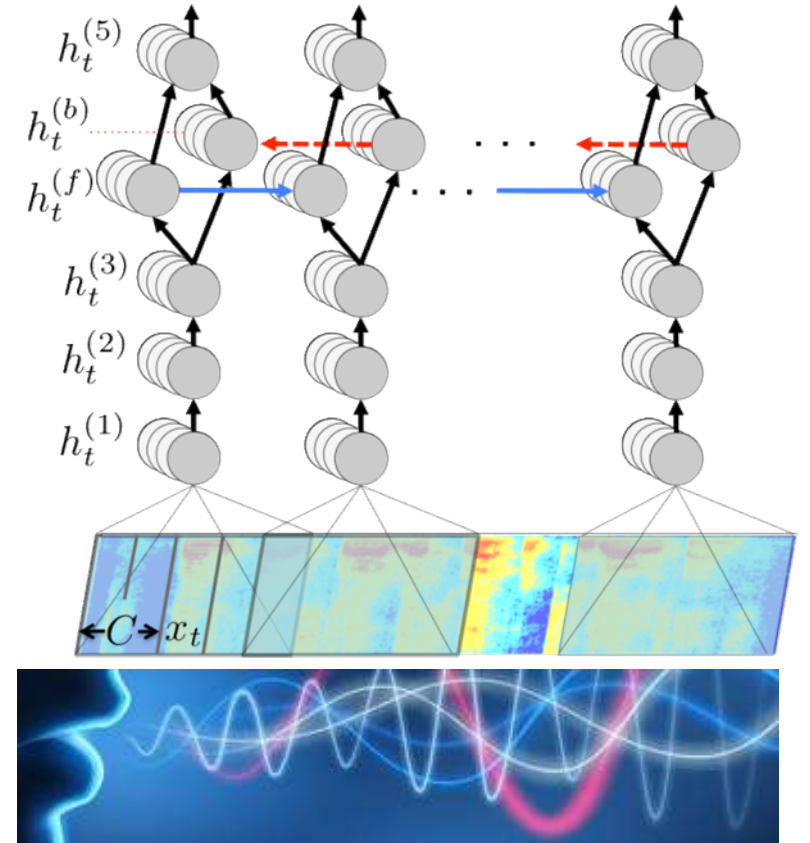
Kaiming He, Xiangyu Zhang, Shaoqing Ren, & Jian Sun. “Deep Residual Learning for Image Recognition”. CVPR 2016.



OBJECT DETECTION

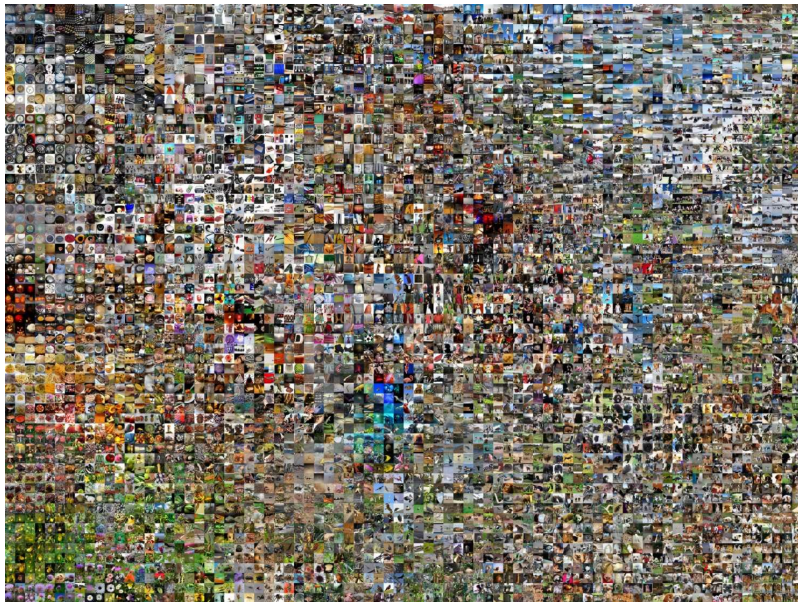


SPEECH RECOGNITION



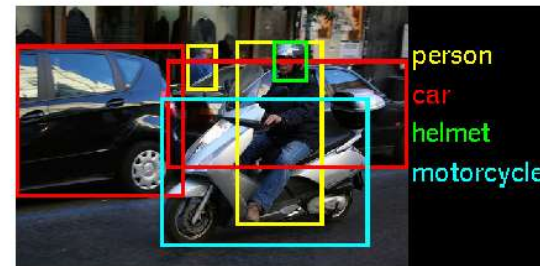
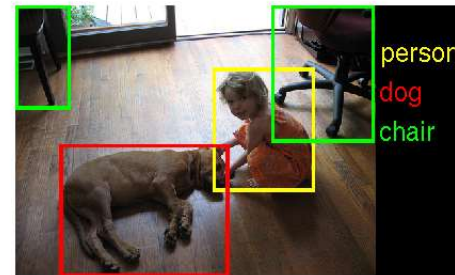
(Artificial) intelligence requires not just data

It is not a matter of just having a lot of data...



Imagenet (14M images)

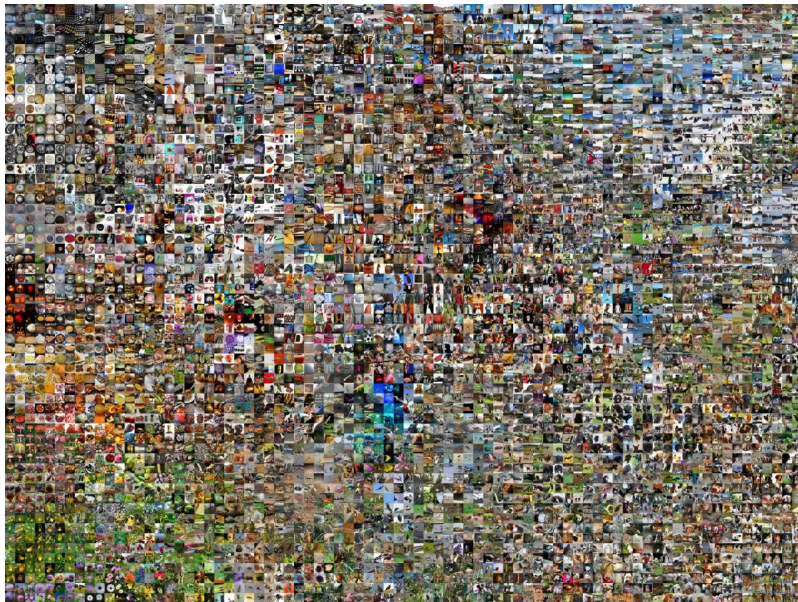
We need good quality data!



Human supervision in labelling data

(Artificial) intelligence requires not just data

It is not a matter of just having a lot of data...



Imagenet (14M images)

We need excellent quality data!



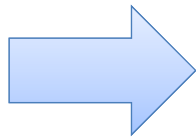
Human experts in labelling data

Intelligence is in the data! The recipe

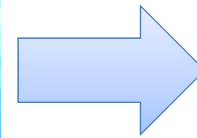
To perform a complex task, we need **high quality data** and for this humans are still necessary and a **highly valuable resource**.



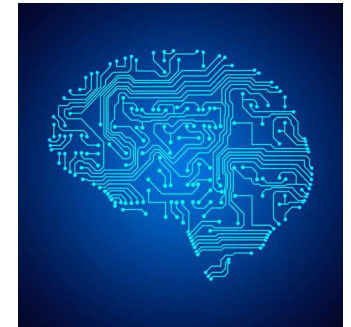
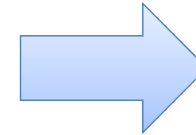
Industry IoT



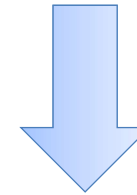
(Big) data generation



Training data

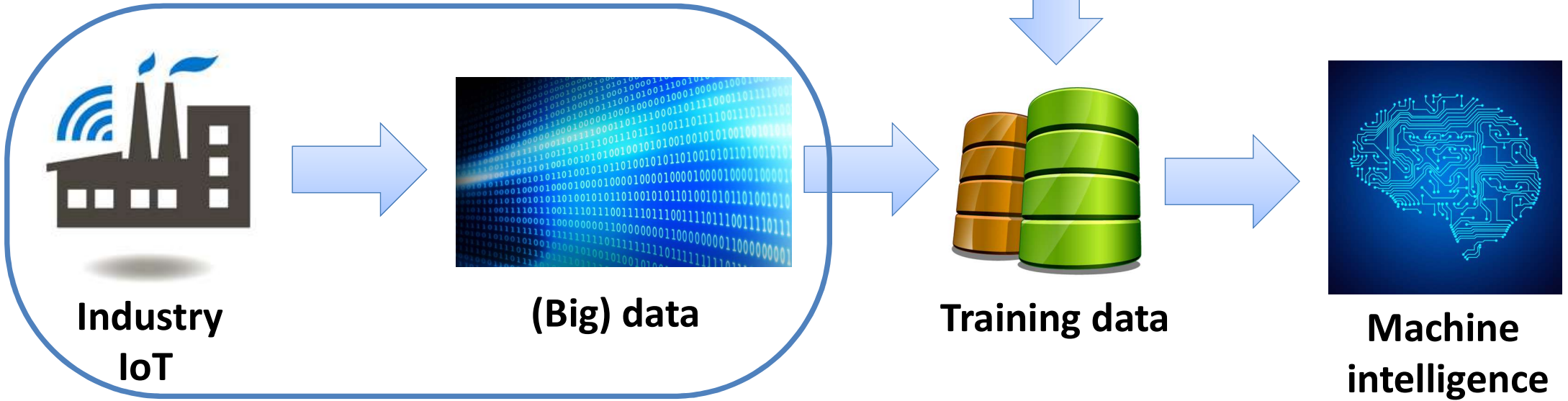


Machine intelligence



Optimization, optimization, optimization...

Efficient digitization of industrial processes: maintenance, manufacturing, quality control, fault detection, customer feedback, etc.

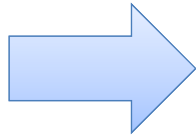


Optimization, optimization, optimization...

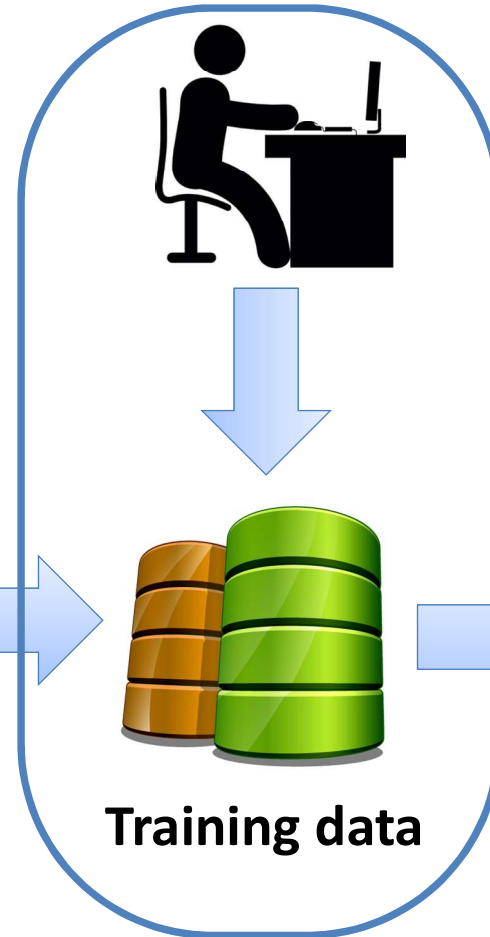
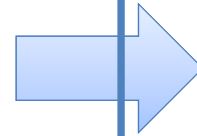
User friendly labelling, training interfaces at the operator side, less accuracy requested for annotations, supervision over the machine learning algorithms.



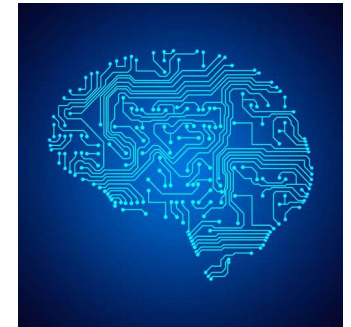
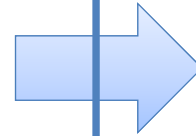
Industry IoT



(Big) data



Training data

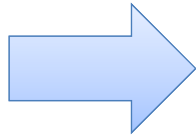


Machine intelligence

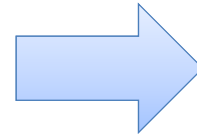
Optimization, optimization, optimization...



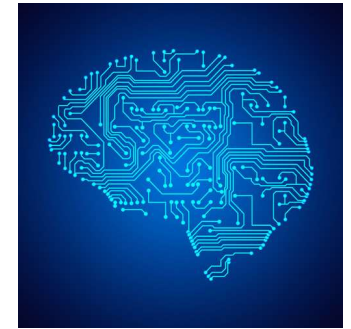
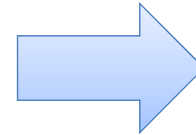
Industry IoT



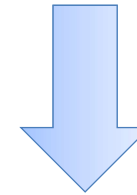
(Big) data



Training data



Machine intelligence



Less data requested,
more efficient
optimization,
generalisation of the
pipeline



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