

Scuola universitaria professionale
della Svizzera italiana

SUPSI

Dipartimento tecnologie innovative

Università
della
Svizzera
italiana



Innovation through Artificial Intelligence

ZHAW

December 17th 2019

Luca Maria Gambardella, director IDSIA

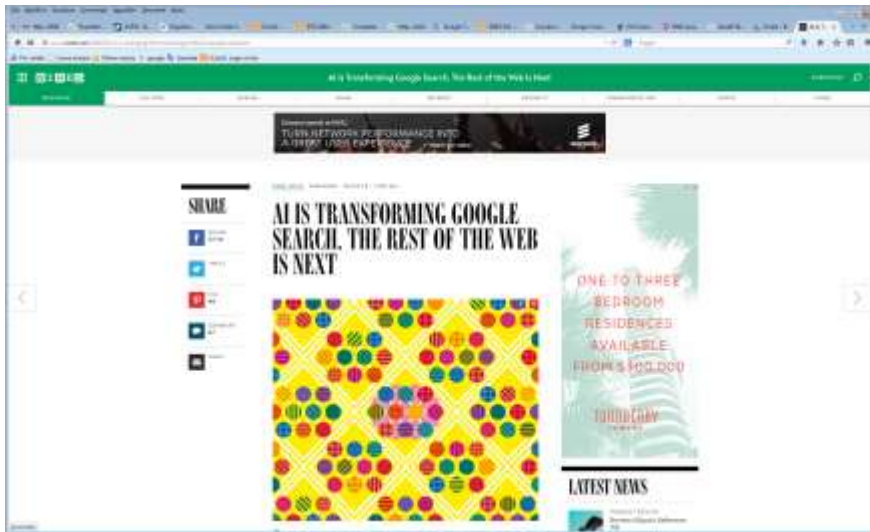
Lugano – Switzerland – www.idsia.ch

What is Artificial Intelligence?

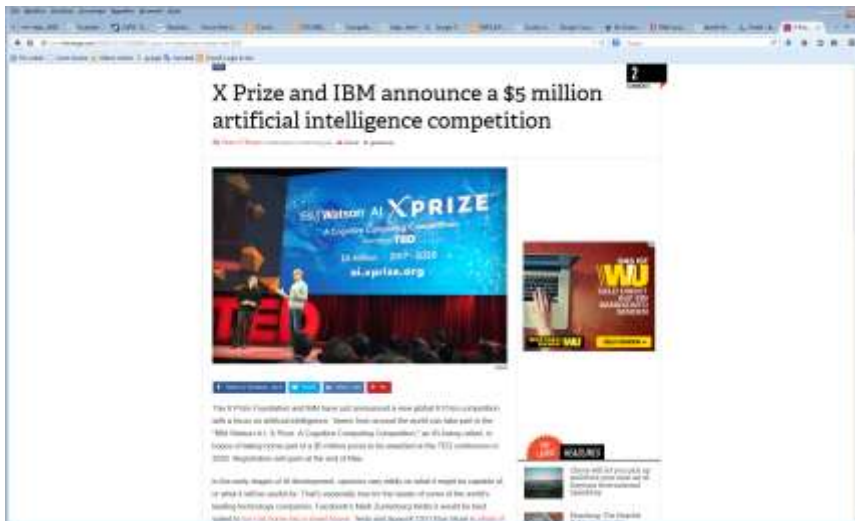
AI is a set way to solve problems inspired by the way people use their nervous systems and bodies to sense, learn, reason, and take action

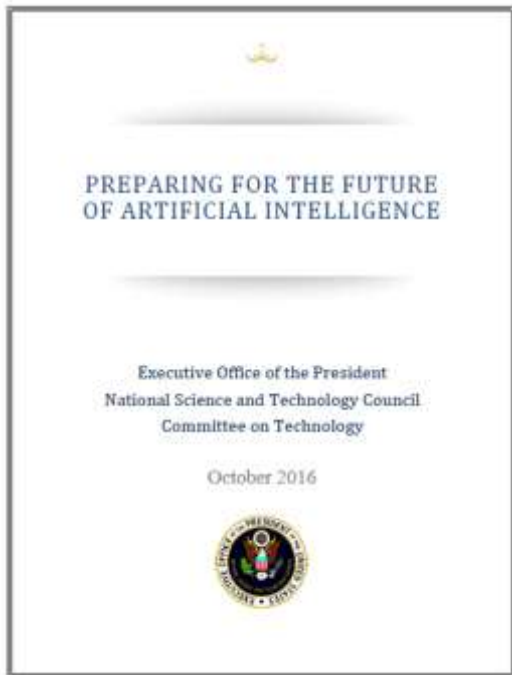


AI is out of accademia since 2012



- Image Recognition
- Speech Recognition
- Language Translation
- Self-Driving Cars
- Health Care
- Retail and eCommerce





House of Commons
Science and Technology
Committee

Robotics and artificial intelligence

Fifth Report of Session 2016–17

Report, together with formal minutes relating to the report

Ordered by the House of Commons to be printed
13 September 2016

China Is Quickly Becoming an AI Superpower

• Peter H. Diamandis, MD ^{2 months ago}



Last year, China's government put out its plan to lead the world in AI by 2030.

As Eric Schmidt has [explained](#), "It's pretty simple. By 2020, they will have caught up. By 2025, they will be better than us. By 2030, they will dominate the industries of AI."

☰
Israel needs national vision for AI or risks falling behind, tech authority says

MARCH 10, 2019
COMMENT TOP STORIES



Ethiopian Airlines plane crashes with 157 aboard, no survivors

By AP and THE STAR

Unofficial reports say at least 1 Israeli tourist to have been on board. Addis Ababa, Ethiopia flight, other used by Israeli tourists to Eritrea

Amid Likud's 'Bibi or Tibi' campaign, ADL slams 'demonization' of Israeli Arabs

By MICHAEL BAZDORF

An PM reportedly wants Qatari will form government with Arab parties. ADL sees 'demonization' in 'unacceptable' premier's speech with reality TV host who slanders his netpage

Israel needs national vision for AI or risks falling behind, tech authority says

Israel Innovation Authority urges government, academia, industry to join forces for advances in artificial intelligence as global race is underway

By BRODSHARNA GOLDMAN
14 January 2019, 5:01 am | 98

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[in](#)
[v](#)
[d](#)
106



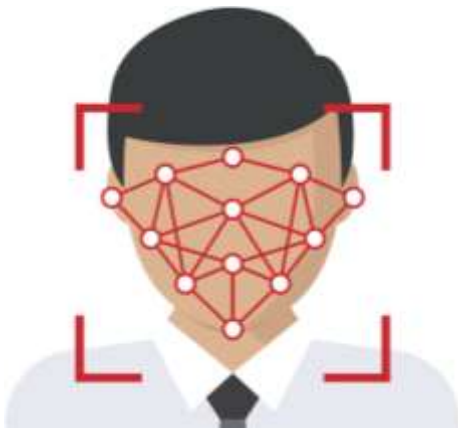
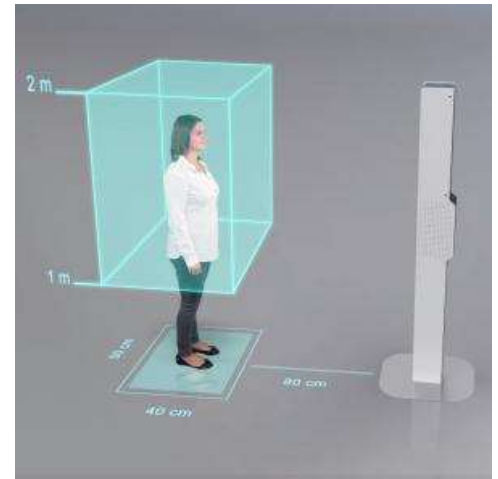
Select Committee on Artificial Intelligence



HIS EXCELLENCY OMAR BIN SULTAN AL OLAMA

Minister of State for Artificial Intelligence

His Excellency Omar bin Sultan Al Olama has been appointed as Minister of State for Artificial Intelligence following the Cabinet reshuffle of October 2017. His responsibilities include enhancing the government performance by investing the latest technologies and tools of artificial intelligence and applying them in various sectors.





LUGANO



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della Svizzera italiana.

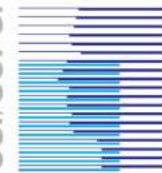
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innovative



Università
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Svizzera
italiana

USI/SUPSI



Istituto
Dalle Molle
di studi
sull'intelligenza
artificiale

IDSIA

IDSIA is a research institute on Artificial Intelligence founded in 1988 in Lugano



Thanks to italian philanthropist
Angelo Dalle Molle (1908-2002)



Now about 80 people:
8 Professors, 36 PostDocs/Sw Engineers
19 PhD students, 10 Master students

«Die Fortschritte der Wissenschaft im Allgemeinen und die der aufstrebenden Informatik im Besonderen den Menschen nicht unterwerfen, sondern ihm nützen sollten.»

IDSIA is a common
USI and SUPSI since 2000

2.0M - 100 papers x year

**Machine Learning – Deep NN
Swarm Optimization - Robotics**

2.0M – 15-20 running projects

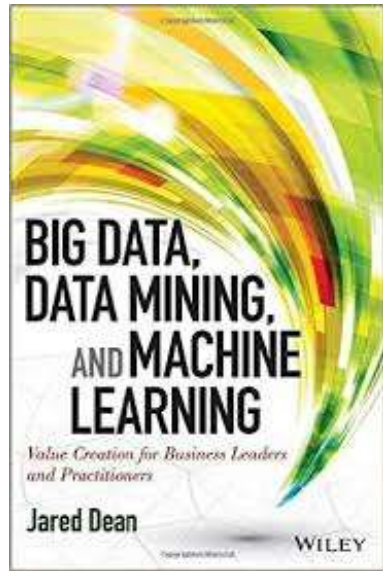
MODERN DATA SCIENTIST

Data Scientist, the sexiest job of the 21st century, requires a mixture of multidisciplinary skills ranging from an intersection of mathematics, statistics, computer science, communication and business. Finding a data scientist is hard. Finding people who understand who a data scientist is, is equally hard. So here is a little cheat sheet as to what the modern data scientist really is.

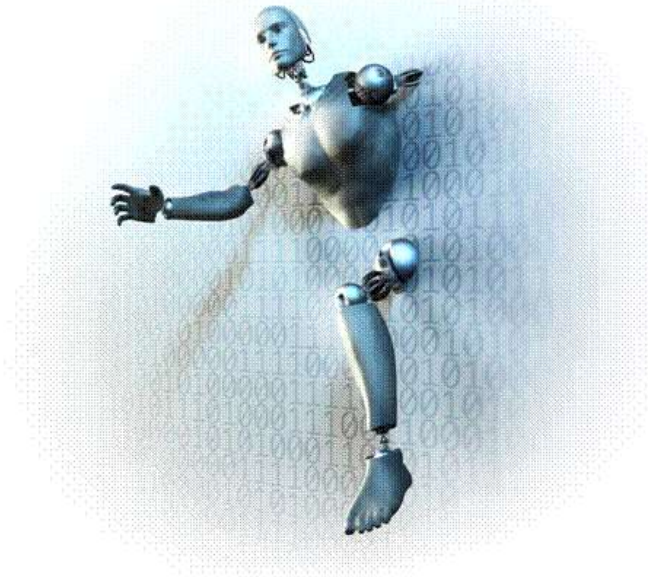
<h4>MATH & STATISTICS</h4> <ul style="list-style-type: none"> ★ Machine learning ★ Statistical modeling ★ Experimental design ★ Bayesian inference ★ Supervised learning: decision trees, random forests, logistic regression ★ Unsupervised learning: clustering, dimensionality reduction ★ Optimization: gradient descent and variants 	<h4>PROGRAMMING & DATABASE</h4> <ul style="list-style-type: none"> ★ Computer science fundamentals ★ Scripting language e.g. Python ★ Statistical computing packages, e.g., R ★ Databases: SQL, nosql (HSQL) ★ Relational Algebra ★ Parallel databases and parallel query processing ★ MapReduce concepts ★ Hadoop and Hadooping ★ Custom reducers ★ Experience with cloud like AWS
<h4>DOMAIN KNOWLEDGE & SOFT SKILLS</h4> <ul style="list-style-type: none"> ★ Passionate about the business ★ Curious about data ★ Influence without authority ★ Hacker mindset ★ Problem solver ★ Strategic, proactive, creative, innovative and collaborative 	<h4>COMMUNICATION & VISUALIZATION</h4> <ul style="list-style-type: none"> ★ Able to engage with senior management ★ Story telling skills ★ Translate data driven insights into decisions and actions ★ Visual art design ★ R packages like ggplot or lattice ★ Knowledge of any of visualization tools e.g. Tableau, D3.js, Tableau



What is AI today?



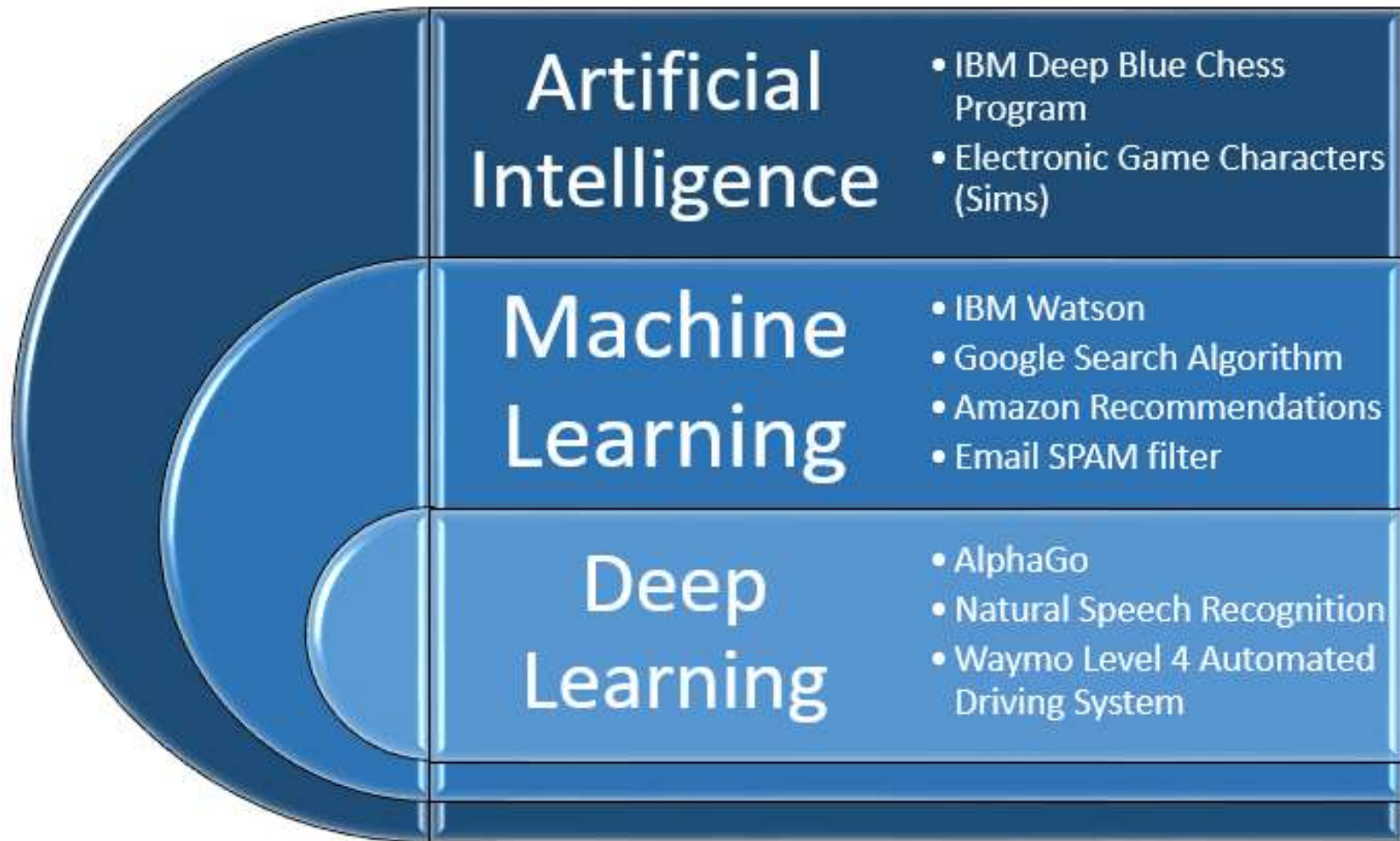
Industry
4.0



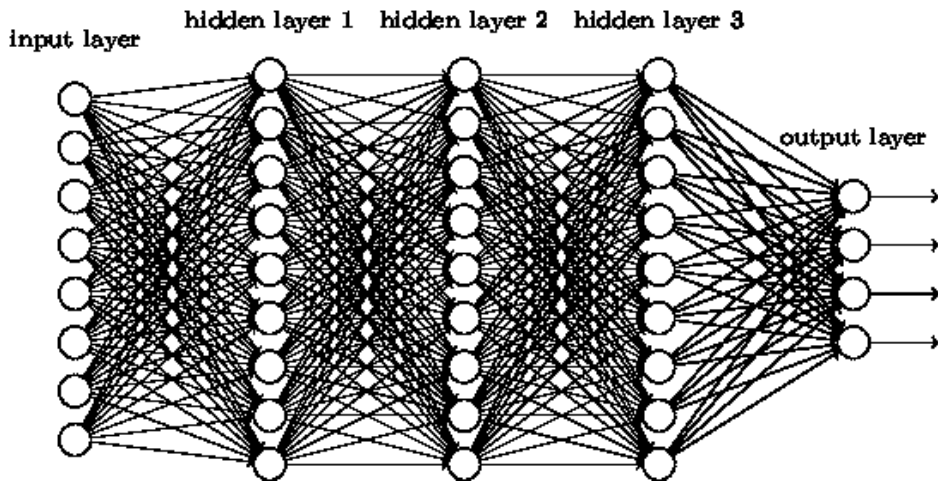
robotics



More in detail

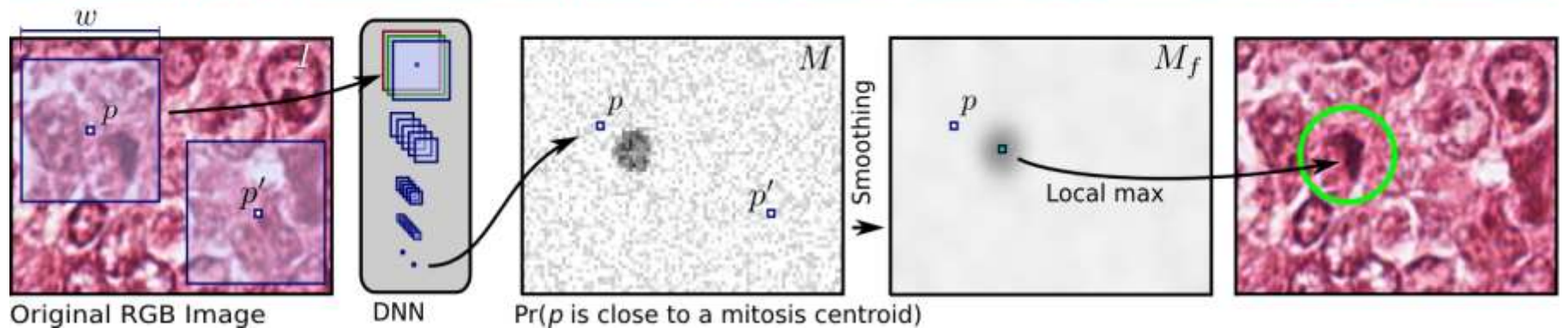
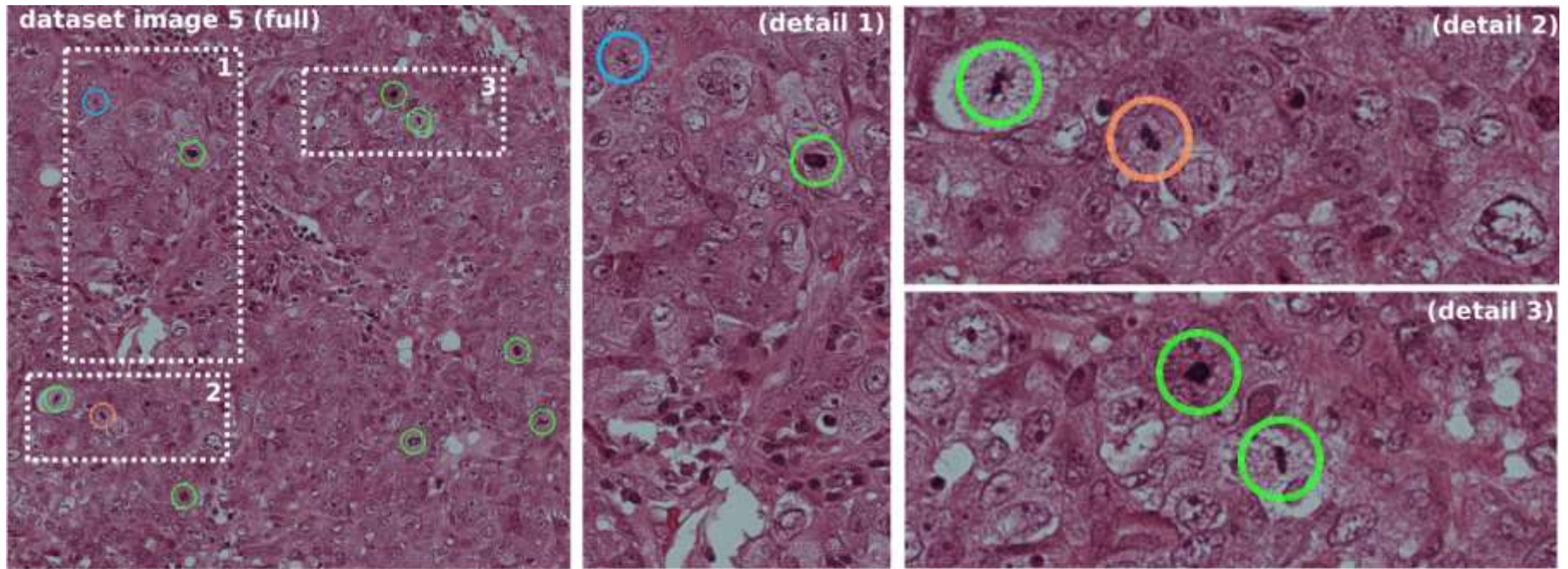


Deep Machine Learning



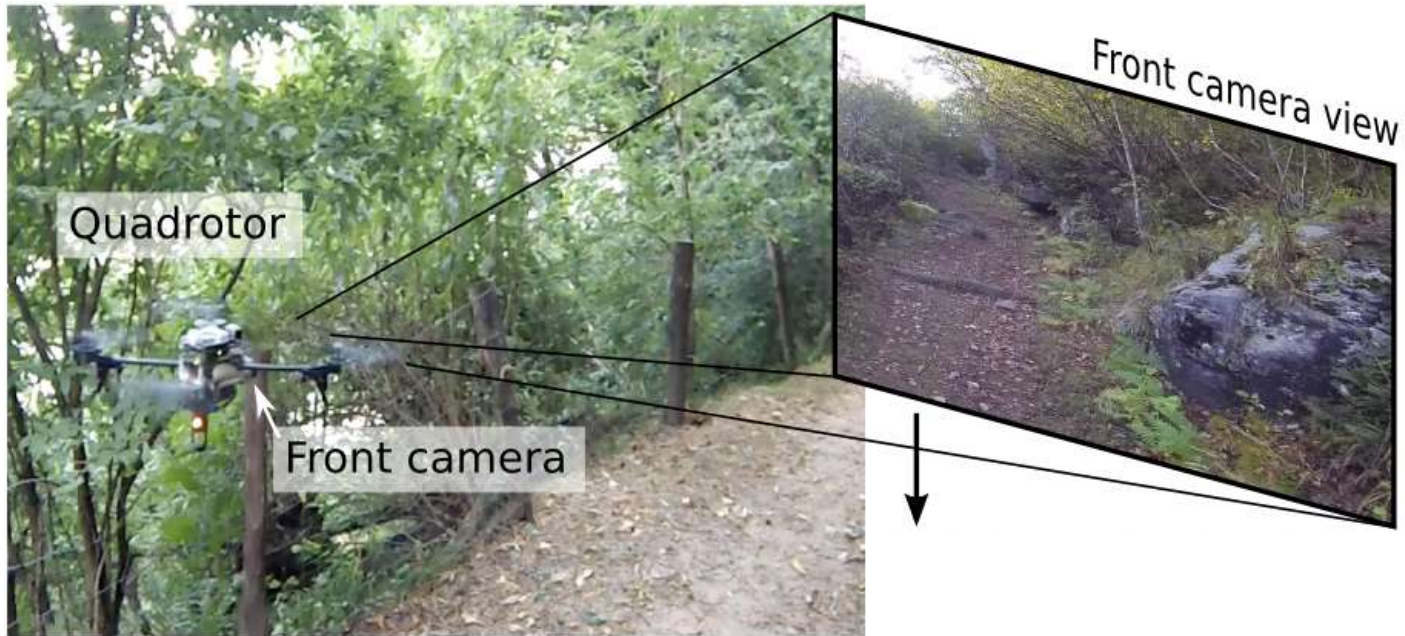
Deep Neural Networks

Detection of mitotic nuclei in breast cancer histology images



A Deep Machine Learning approach to Visual Perception based navigation in Forest Trails

- MAV autonomously follows a forest trail
- Applications in search and rescue



Teaching by examples



20^k
of images



The drone with an artificial brain

MAV Navigation in the Forests Trail Following under the Tree Canopy



IDSIA, Lugano, Switzerland
RPG, University of Zurich, Switzerland
<http://www.bit.ly/perceivingtrails>

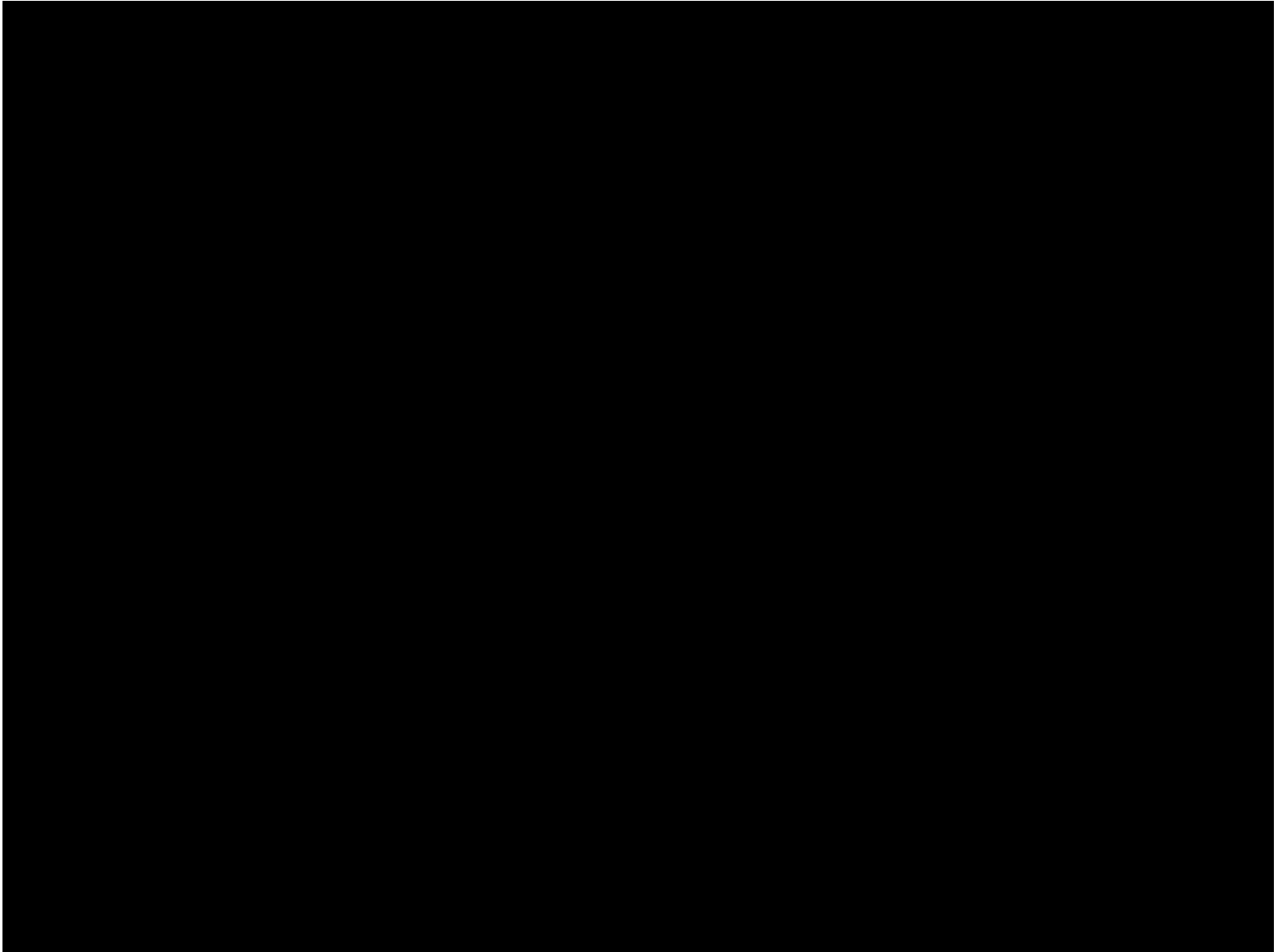


NCCR Robotics subproject 4.7

Swiss National
Centre of Competence
in Research



Inside the Drone's Artificial Brain



One of our Phd student is one of the three founders of Google DeepMind

Google to acquire artificial intelligence company Deep Mind

Monday, Jan 27 2014, 10:57 GMT

Google is reportedly close to acquiring artificial intelligence company Deep Mind.

The web giant has agreed to pay \$500 million (£302m) for the London-based startup

DeepMind is a cutting edge artificial intelligence company. We combine the best techniques from machine learning and systems neuroscience to build powerful general-purpose learning algorithms.



50 people in 2014
700 people in 2018

Co-Founder & Chief Scientist, DeepMind

Shane obtained his PhD from IDSIA in Switzerland, supervised by Prof. Marcus Hutter, the leading authority on theoretical models of super intelligent machines. His thesis proposed a formal definition of machine intelligence, for which he was awarded the \$10,000 Canadian Singularity Institute research prize. He spent a post doctoral year at the Swiss Finance Institute building models of human decision making, followed by two years at the Gatsby Computational Neuroscience Unit at UCL studying the algorithmic organisation of the brain. In 2010 he co-founded DeepMind Technologies with Demis Hassabis and Mustafa Suleyman. After three years of rapid growth and a number of research breakthroughs, DeepMind was acquired by Google.

Dr Shane Legg



SUPSI

> SUPSI
> Bachelor, Diploma and Master
> Continuing education
> Research

Profession
and Passion

Celine Cornetti, Student,
Engineering and Management.
Flexibility, versatility,
inter-disciplinarity and technology
are future of tomorrow.

People directory

Search details

NEW SEARCH

First name

Last name, Surname or phone number

Contacts

Name and Surname

Publications

Share Legg

We give voice to Google !!!!



Google Research Blog

The latest news from Research at Google

Google voice search: faster and more accurate

Posted: Thursday, September 24, 2015



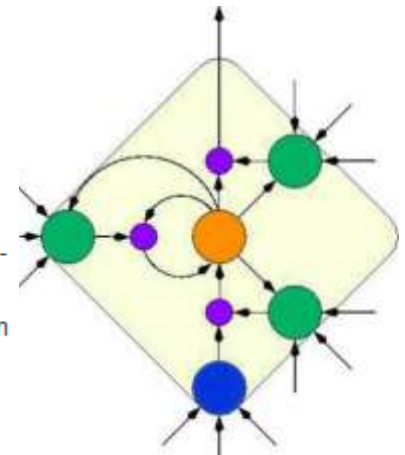
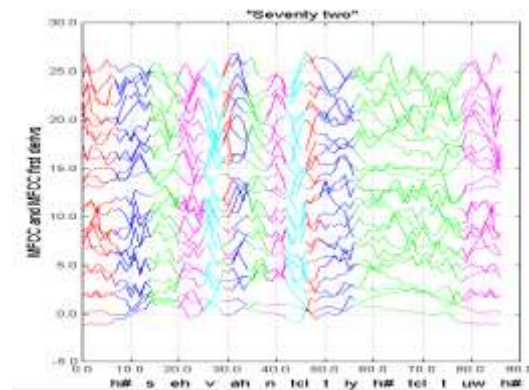
1,346



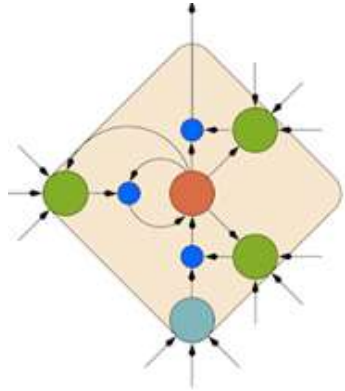
Posted by Haşim Sak, Andrew Senior, Kanishka Rao, Françoise Beaufays and Johan Schalkwyk – Google Speech Team

Back in 2012, [we announced](#) that Google voice search had taken a new turn by adopting [Deep Neural Networks \(DNNs\)](#) as the core technology used to model the sounds of a language. These replaced the 30-year old standard in the industry: the Gaussian Mixture Model (GMM). DNNs were better able to assess which sound a user is producing at every instant in time, and with this they delivered greatly increased speech recognition accuracy.

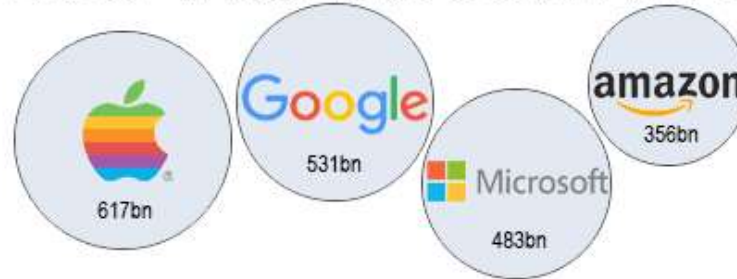
Our improved acoustic models rely on Recurrent Neural Networks (RNN). RNNs have feedback loops in their topology, allowing them to model temporal dependencies: when the user speaks /u/ in the previous example, their articulatory apparatus is coming from a /j/ sound and from an /m/ sound before. Try saying it out loud - "museum" - it flows very naturally in one breath, and RNNs can capture that. The type of RNN used here is a [Long Short-Term Memory \(LSTM\)](#) RNN which, through memory cells and a sophisticated gating mechanism, memorizes information better than other RNNs. Adopting such models [already improved the quality](#) of our recognizer significantly.



One of the most used Deep NN LSTM (Long Short Term Memory) was invented in **IDSIA** and TUM in 1997



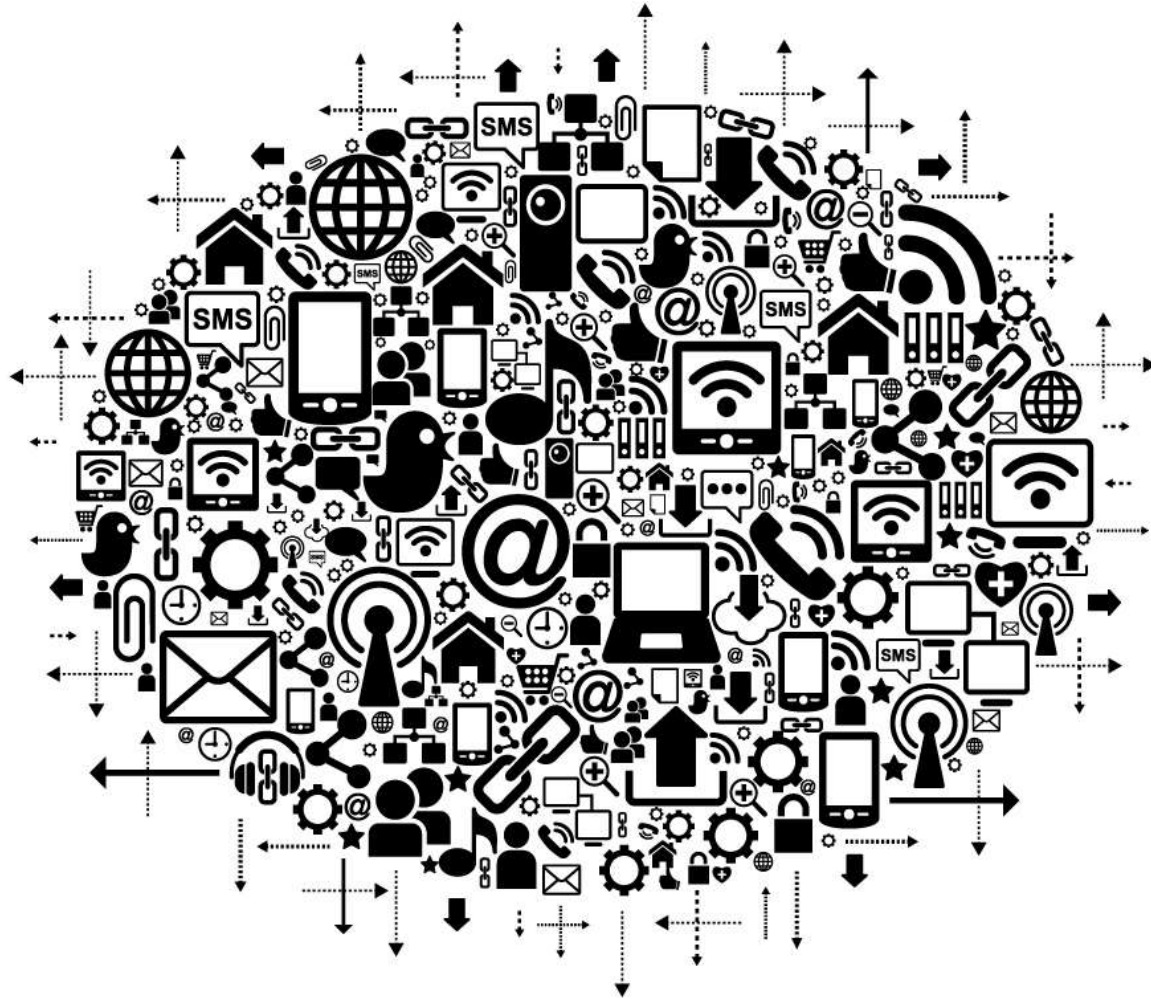
OUR IMPACT ON THE WORLD'S MOST VALUABLE COMPANIES



Machine learning

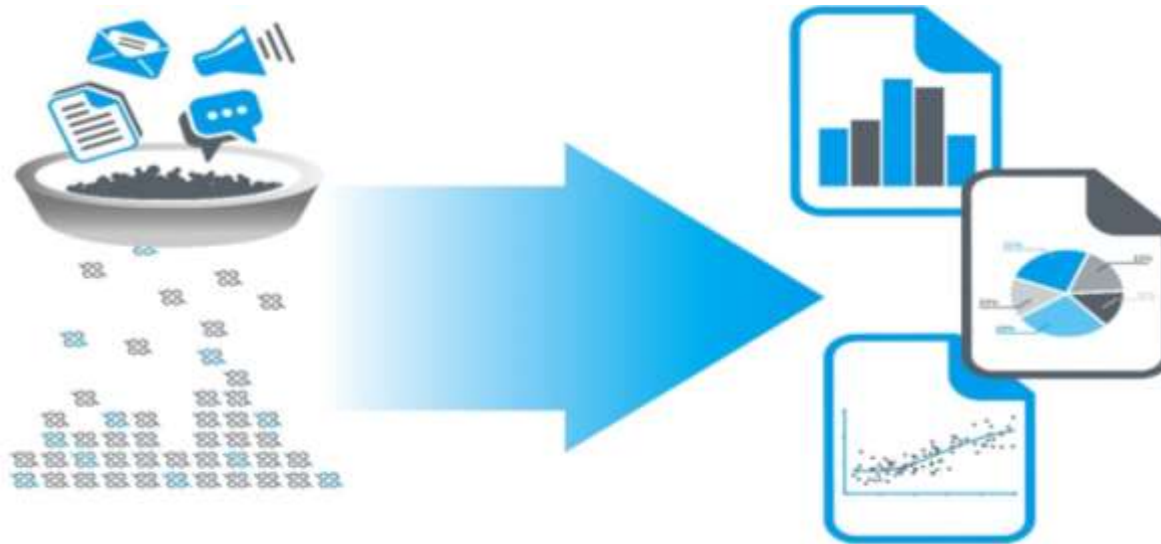
(Unstructured) Data

- Numbers
- Chars/texts
- Sounds
- Images/clips
- Graphs
- DNA ...



Learning from (BIG) data

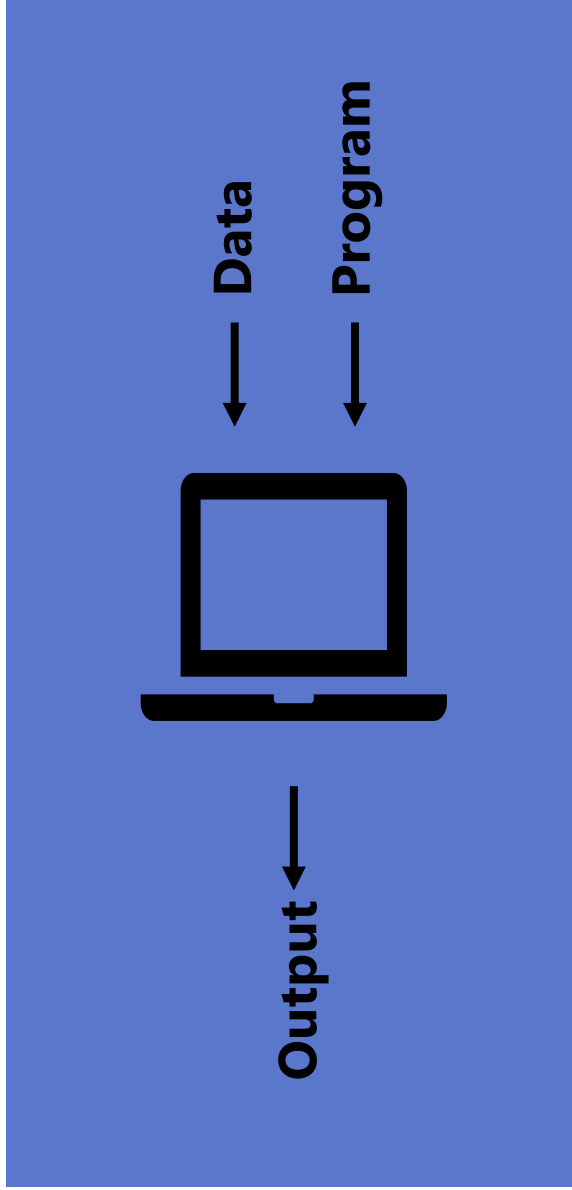
→ Search for patterns in data



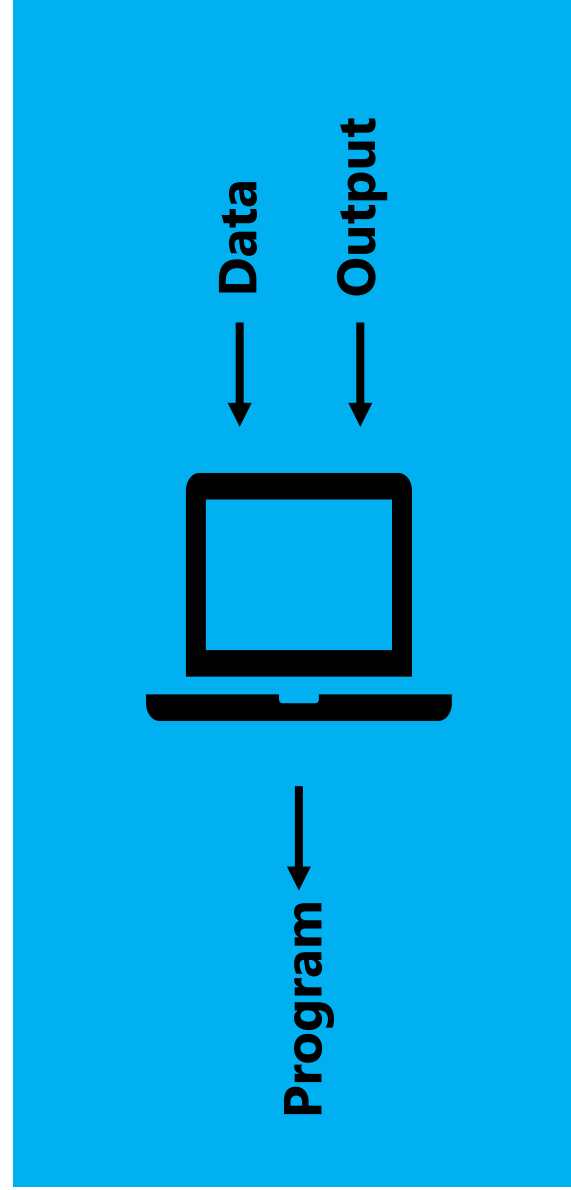
- set of patterns = a **model**
- allows us to structure information
- Models **can be queried**
 - for prediction, diagnosis, recognition, ...
- (Sort of) Domain independent
 - the meaning of data is not always needed



Traditional Programming



Machine Learning

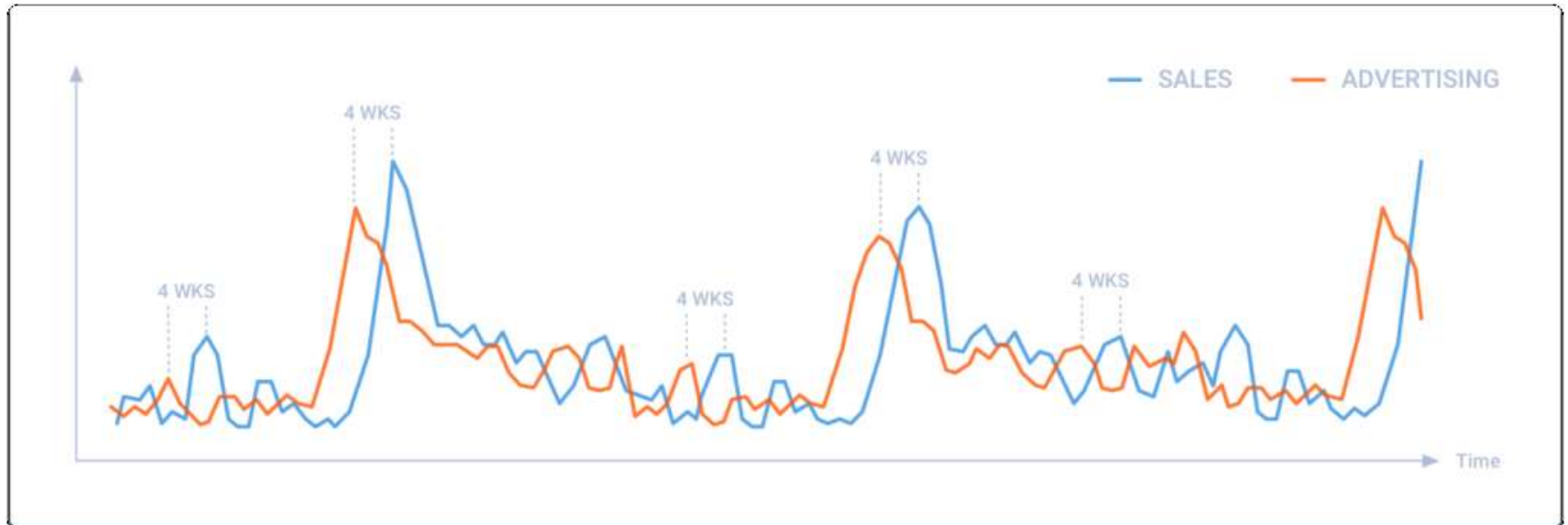
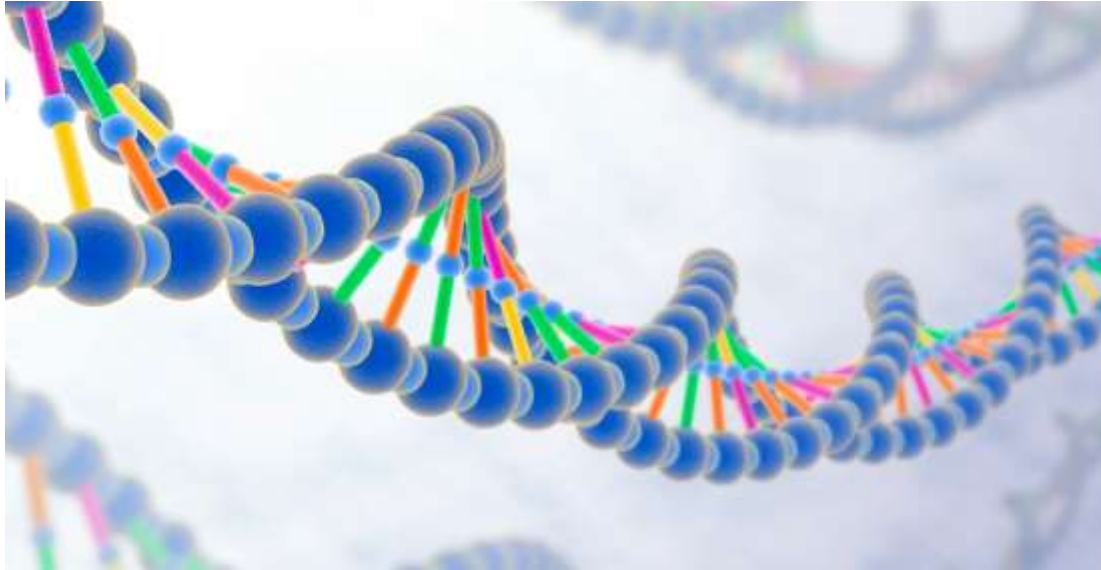


Some applications

Novartis
(Basel)



NOVARTIS



DXT Commodities (Lugano)

Energy markets

Trading of energy and optimisation of wind & solar plants

DufEnergy Trading
Duferco GROUP



DXT
COMMODITIES

USI/SUPSI
Istituto
Dalle Molle
di studi
sull'intelligenza
artificiale
IDSIA

KTI/CTI

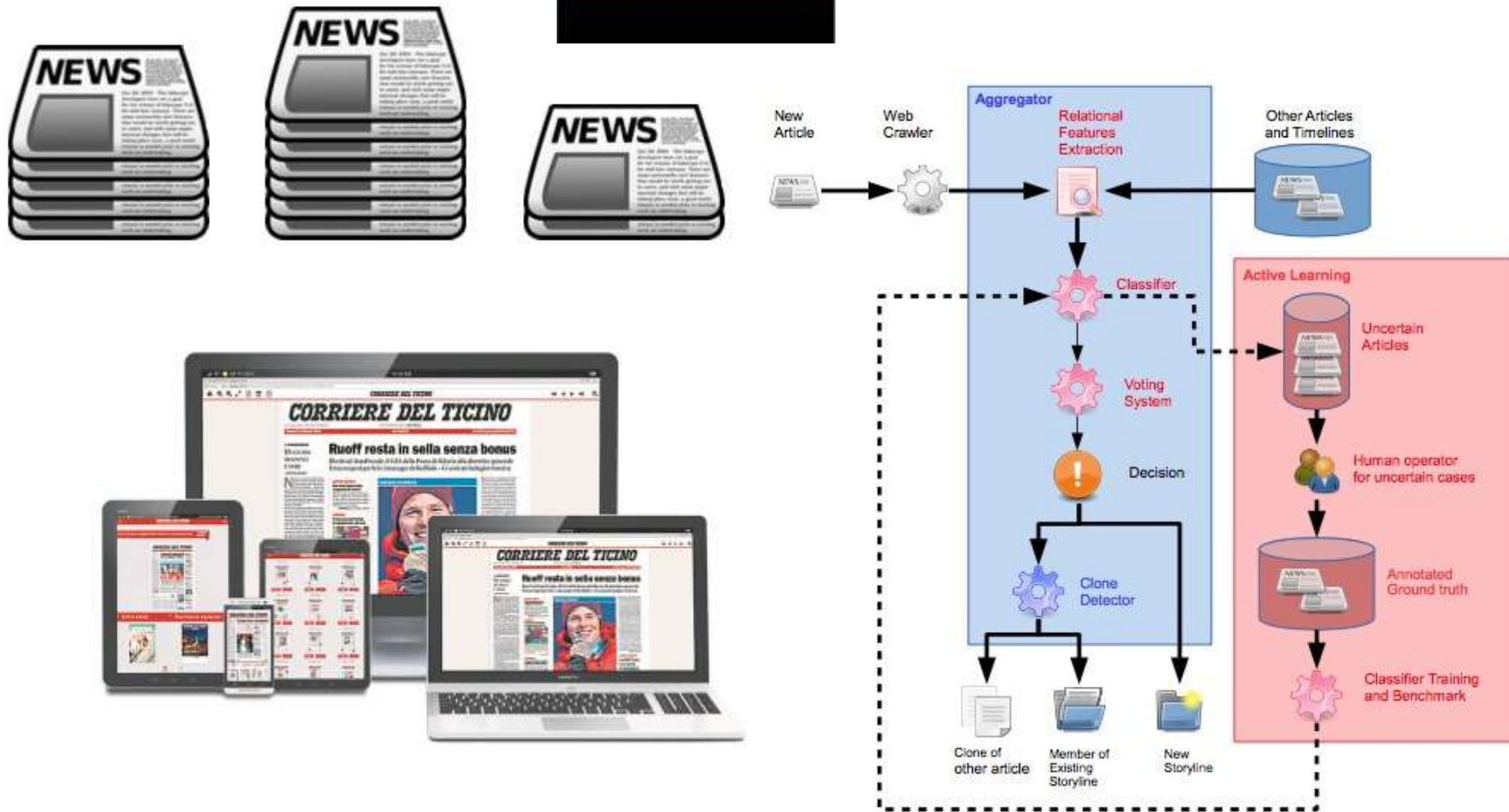


Corriere del Ticino (Lugano)

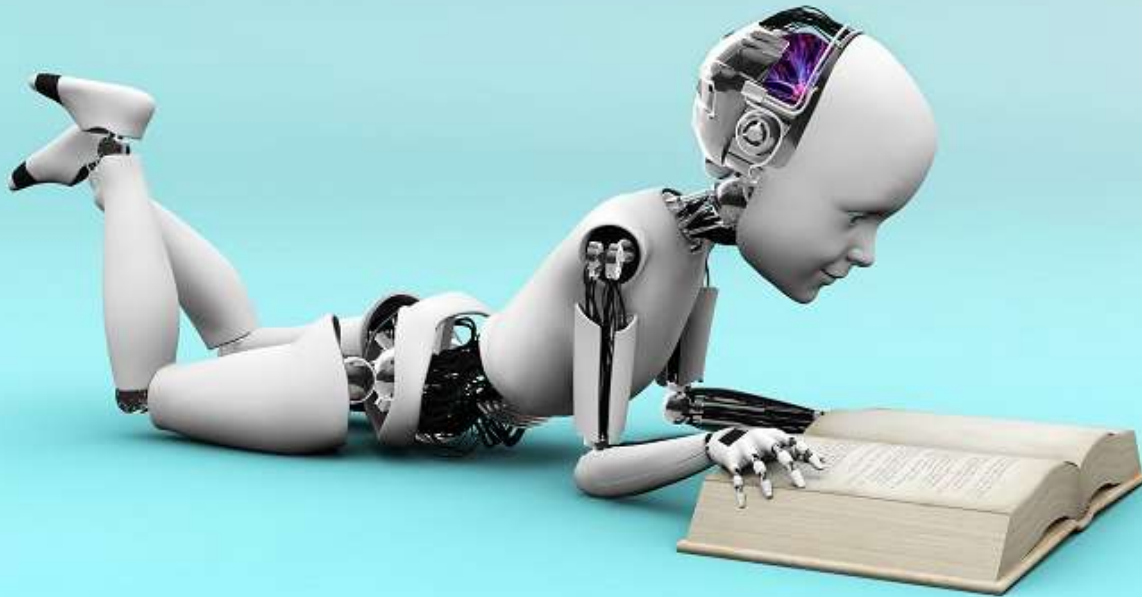
CORRIERE DEL TICINO



Profiling readers Personalised ads and news



C-Labs & SGS
(Manno, Geneve)



EUROPEAN COMMISSION
HEALTH AND CONSUMERS DIRECTORATE-GENERAL

December 2012

GUIDANCE DOCUMENT FOR COMPETENT AUTHORITIES FOR THE CONTROL OF COMPLIANCE WITH EU LEGISLATION ON:

Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004

Food Safety Authority of Ireland Launches Consultation on EU Rules on Prepacked Foods

Email Print Share     

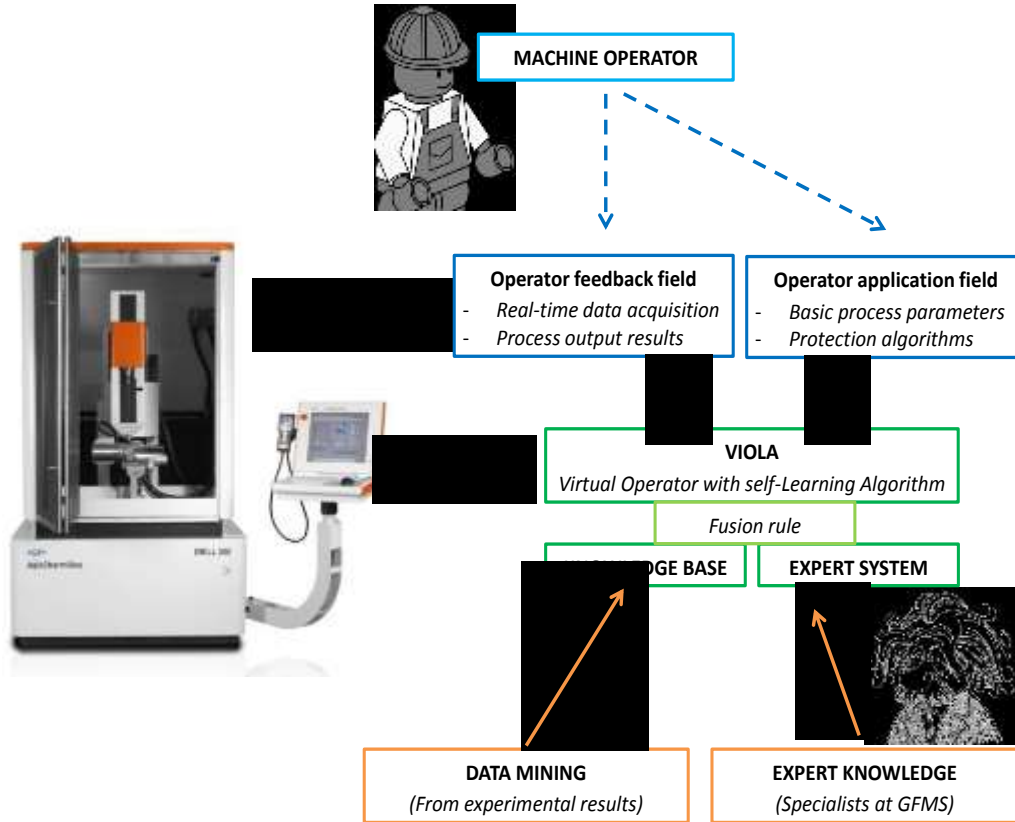
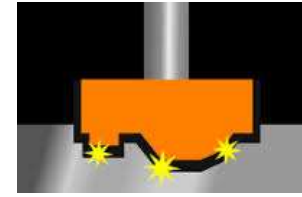
19 Jul 2016 — The Food Safety Authority of Ireland (FSAI) is undertaking a national consultation on EU regulations that allow for some prepacked food products to be exempt from displaying nutrition information.

The consultation is being run in conjunction with the Department of Health and Department of Agriculture, Food and the Marine.

The consultation has been launched on the back of EU regulations which require that most prepacked food products provide mandatory nutritional information to help consumers make more informed choices.



Georg Fischer
(Losone)



KTI/CTI

inspire



Casale sa
(Lugano)

Industry: Predictive maintenance

Predictive maintenance, failure detection and
distance process analytics



AI-CARES

**Advanced artificial intelligence
algorithms embedding expertise
and knowledge on ammonia
plants, lead to a unique service
for automated continuous
monitoring and decision support**

Armasuisse
(Thun)

Strategic Expert System



The screenshot displays the CREDO expert system interface with several panels:

- Main Diagram:** A complex network of nodes (circles) and links (lines) representing relationships between different entities. Nodes are color-coded (green, pink, blue, orange, red).
- Palette:** A sidebar containing tools for 'Select', 'MarkUse', 'Create', 'Link', 'Node', 'Text', 'NOT Node', 'AND Node', 'OR Node', 'XOR Node', 'Query', and 'Observation'.
- Outline:** A list of categories and sub-items, including 'PopPrefLuogo', 'RelazionePaizFam', 'ReteSociale', 'RisorsaTemp', 'SACD', 'ServiziVolontari', 'Sintomatologia', 'SpazioMalattia', 'SpazioIngresso', 'TipoTerapia', 'TrasVVista', and 'Links'.
- Range View:** A bar chart showing the distribution of values for 'Insufficiente', 'Sufficiente', and 'Buono'.
- Dictionary:** A bar chart showing the probability distribution for various linguistic terms.
- Judgments View:** A table showing the results of judgments, including 'Insufficiente', 'Sufficiente', and 'Buono'.
- Mixture View:** A ternary plot showing the mixture of 'Insufficiente' and 'Buono'.

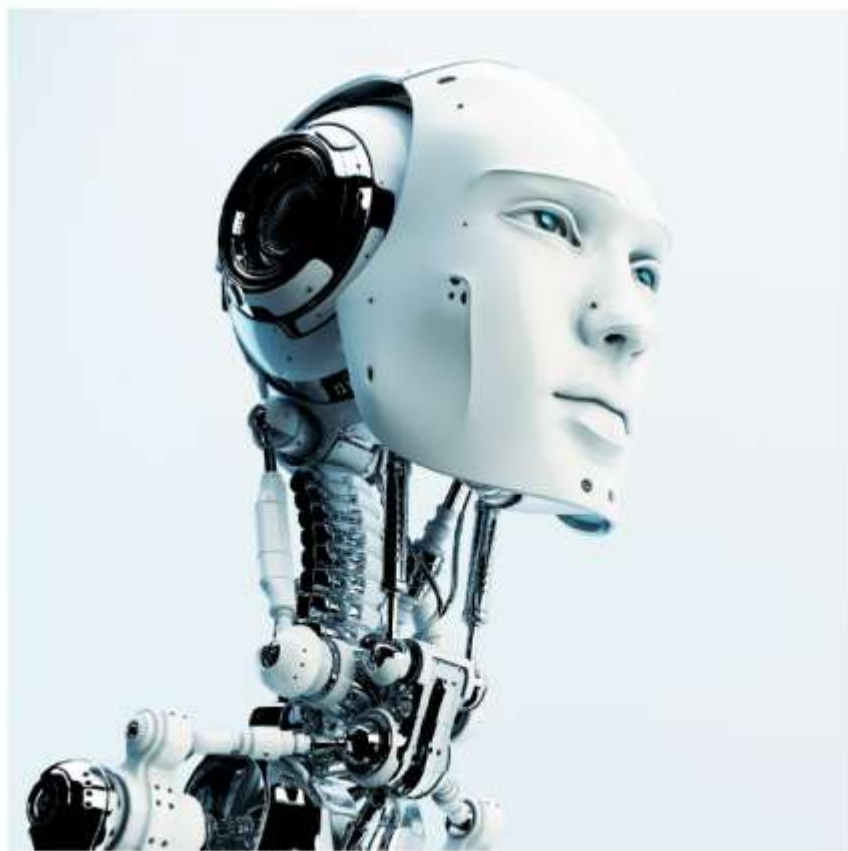


UBS
(Zürich, Manno)



Intelligent Automation

A UBS Group Innovation **White Paper**



Humans and Machines

A **critical appraisal** of the future

UBS' Artificial Intelligence Grab

Wednesday, 17 January 2018 08:56



UBS site in Manno, Ticino/Switzerland

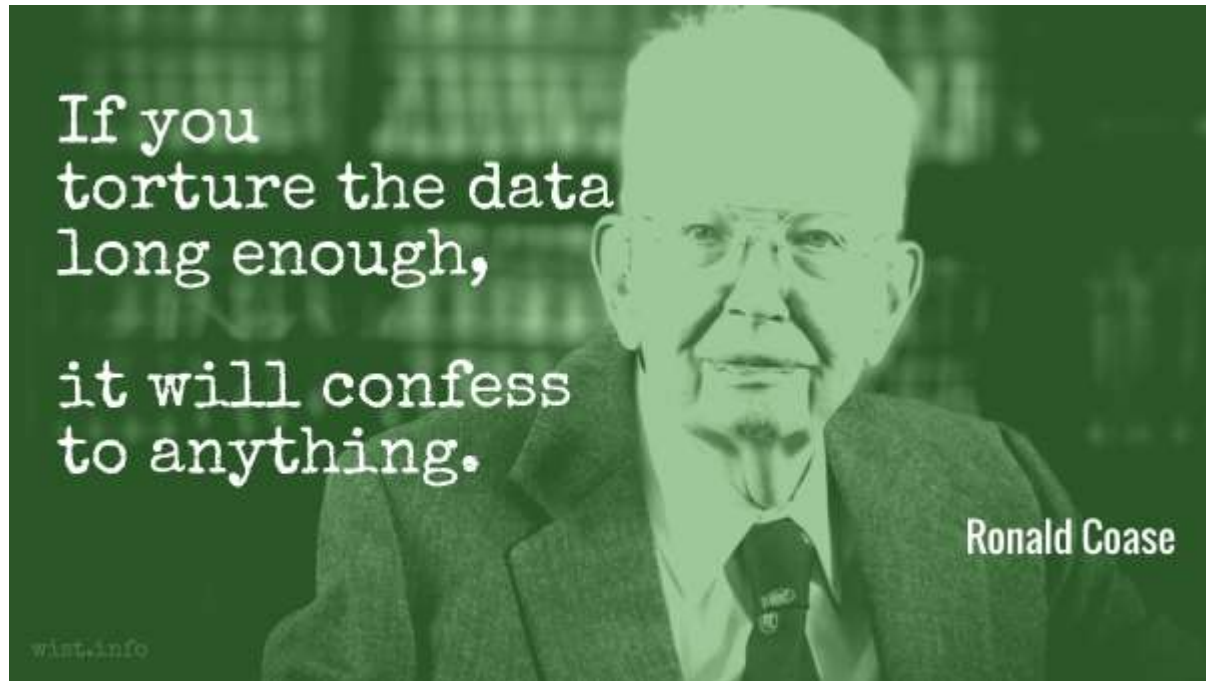
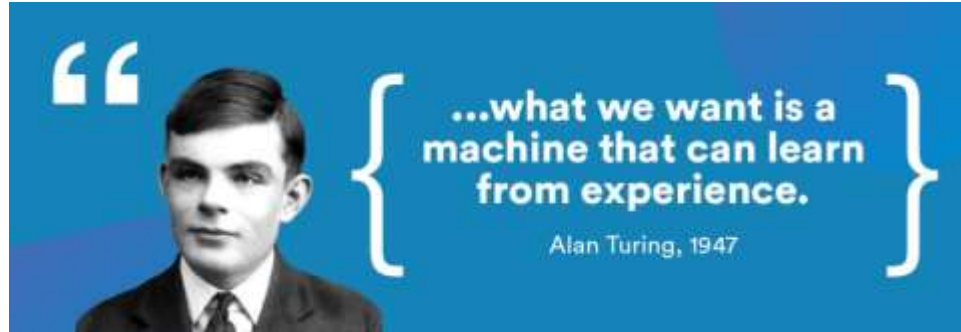
Switzerland's largest bank is expanding a site in Ticino to specialize in artificial intelligence. The move will create 80 new jobs in southern Switzerland.

The University of Lugano IDSIA institute has advanced to a recognized research center for machine learning and artificial intelligence. Now, Zurich-based UBS is linking up with the institute, news agency «AWP» (*behind paywall, in German*) reported on Wednesday.

The bank plans to expand a site in Manno, southern Switzerland, into a center for artificial intelligence, analytics and innovation. The site is to find specific applications for UBS' information technology platform to use big data and artificial intelligence.



Hey, but is it that easy?



Hey, but is it that easy?



**Please measure performance, machine learning is powerful
but you can learn different things from the same data !!!**



MODERN DATA SCIENTIST

Data Scientist, the sexiest job of the 21st century, requires a mixture of multidisciplinary skills ranging from an intersection of mathematics, statistics, computer science, communication and business. Finding a data scientist is hard. Finding people who understand who a data scientist is, is equally hard. So here is a little cheat sheet on who the modern data scientist really is.

MATH & STATISTICS

- ☆ Machine learning
- ☆ Statistical modeling
- ☆ Experiment design
- ☆ Bayesian inference
- ☆ Supervised learning: decision trees, random forests, logistic regression
- ☆ Unsupervised learning: clustering, dimensionality reduction
- ☆ Optimization: gradient descent and variants

DOMAIN KNOWLEDGE & SOFT SKILLS

- ☆ Passionate about the business
- ☆ Curious about data
- ☆ Influence without authority
- ☆ Hacker mindset
- ☆ Problem solver
- ☆ Strategic, proactive, creative, innovative and collaborative



PROGRAMMING & DATABASE

- ☆ Computer science fundamentals
- ☆ Scripting language e.g. Python
- ☆ Statistical computing packages, e.g., R
- ☆ Databases: SQL and NoSQL
- ☆ Relational algebra
- ☆ Parallel databases and parallel query processing
- ☆ MapReduce concepts
- ☆ Hadoop and Hive/Pig
- ☆ Custom reducers
- ☆ Experience with xaaS like AWS

COMMUNICATION & VISUALIZATION

- ☆ Able to engage with senior management
- ☆ Story telling skills
- ☆ Translate data-driven insights into decisions and actions
- ☆ Visual art design
- ☆ R packages like ggplot or lattice
- ☆ Knowledge of any of visualization tools e.g. Flare, D3.js, Tableau

GTC keynote on Tuesday April 5, 2016 Jensen H Huang, CEO of NVIDIA

The prize is the new NVIDIA DGX-1 Deep Learning Supercomputer
valued at 130'000\$

Berkeley

Carnegie Mellon University



Stanford University

Université de Montréal



Frameworks for
Multi-GPU Pascal

Large-scale Deep Learning

Reinforcement Learning

Unsupervised and Transfer
Learning

Natural Language
Understanding

Autonomous Driving

Medical Applications

PIONEERS IN
AI RESEARCH

Swiss Special ICT Award 2016



**One of the best international bio-inspired AI institutes and
Swiss companies directly benefit from the work of its researchers**

robotics⁺

Swiss National
Centre of Competence
in Research



robotics+

Swiss National
Centre of Competence
in Research

en | fr | de

About Us

Wearable
Robotics

Mobile
Robotics

Industry

Students &
Academics

Kids &
Teachers

Equal
Opportunities

Journalists



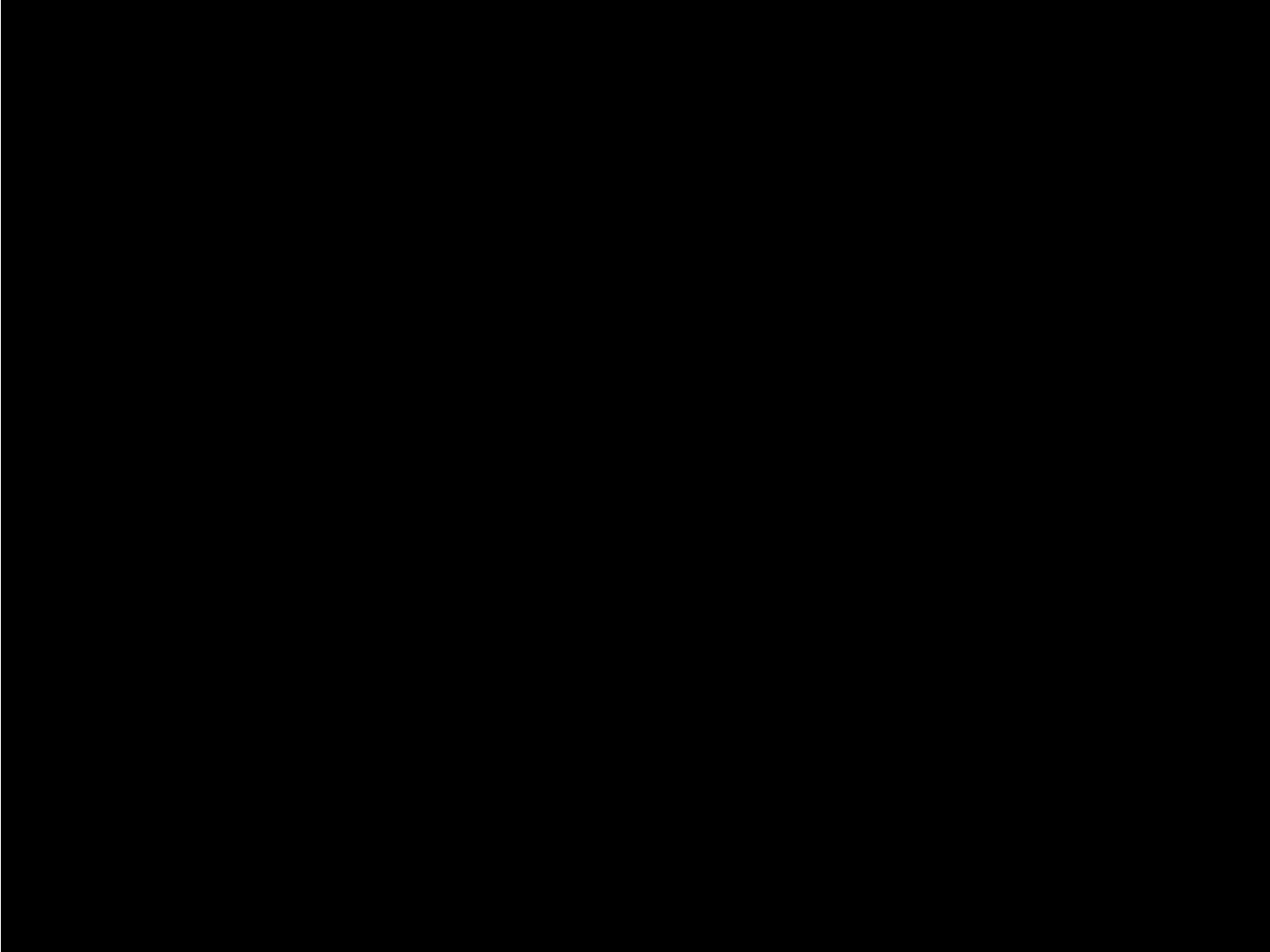
Wearable Robots

NCCR Robotics is a world leader in developing robots that function as assistive aids

NCCR Robotics

Intelligent Robots for Improving the Quality of Life

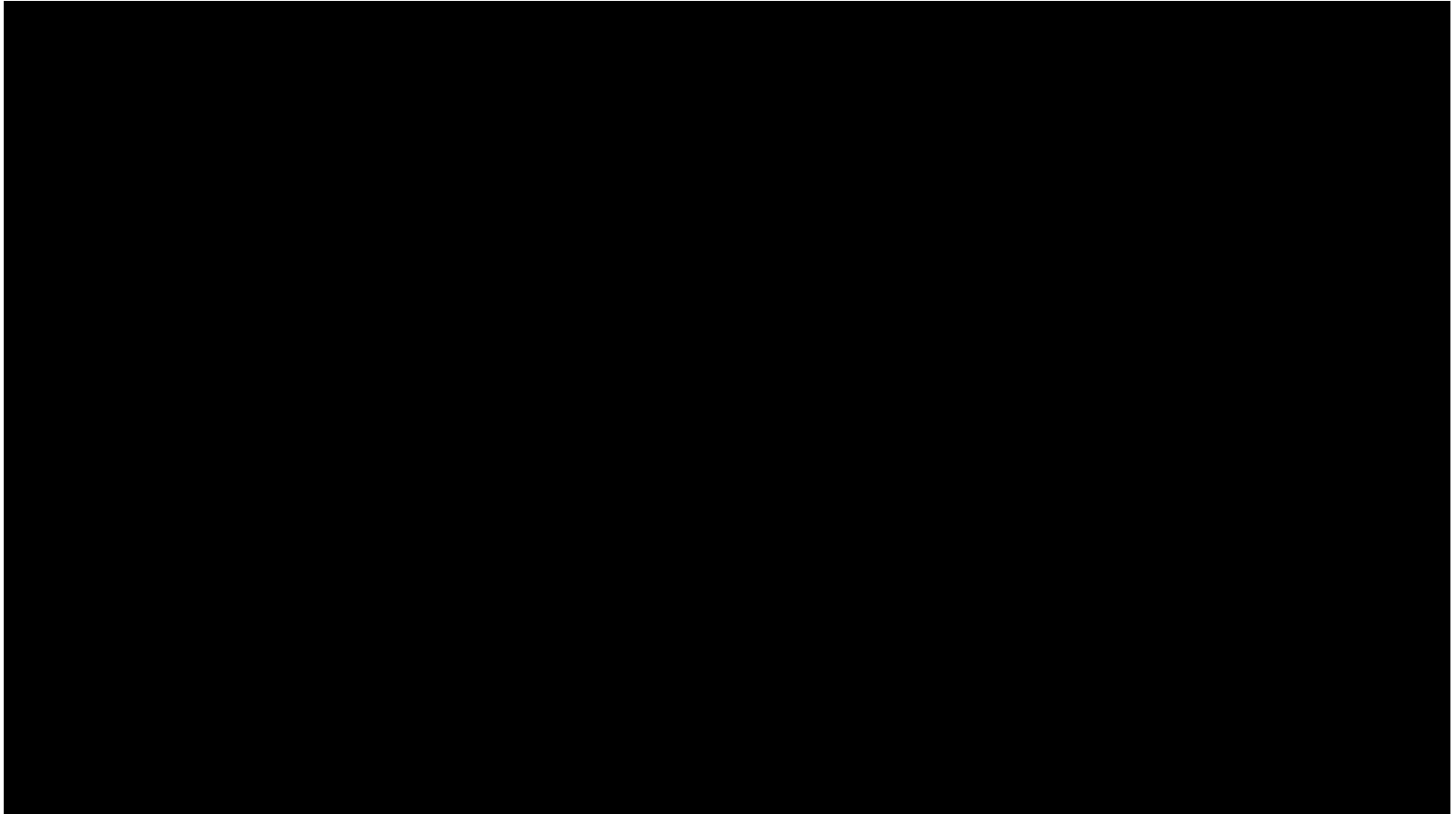
Improve quality of life



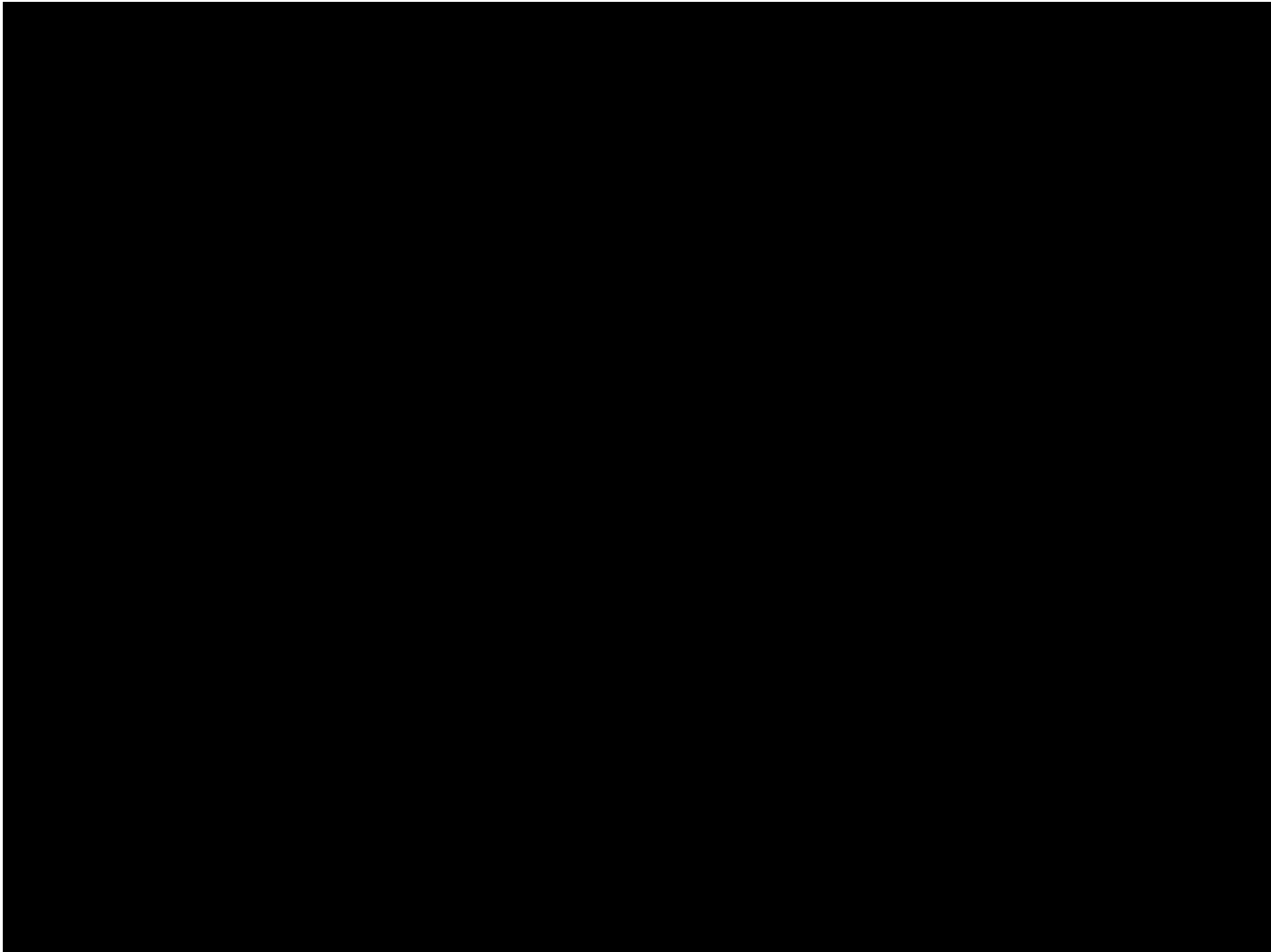


Patent pending

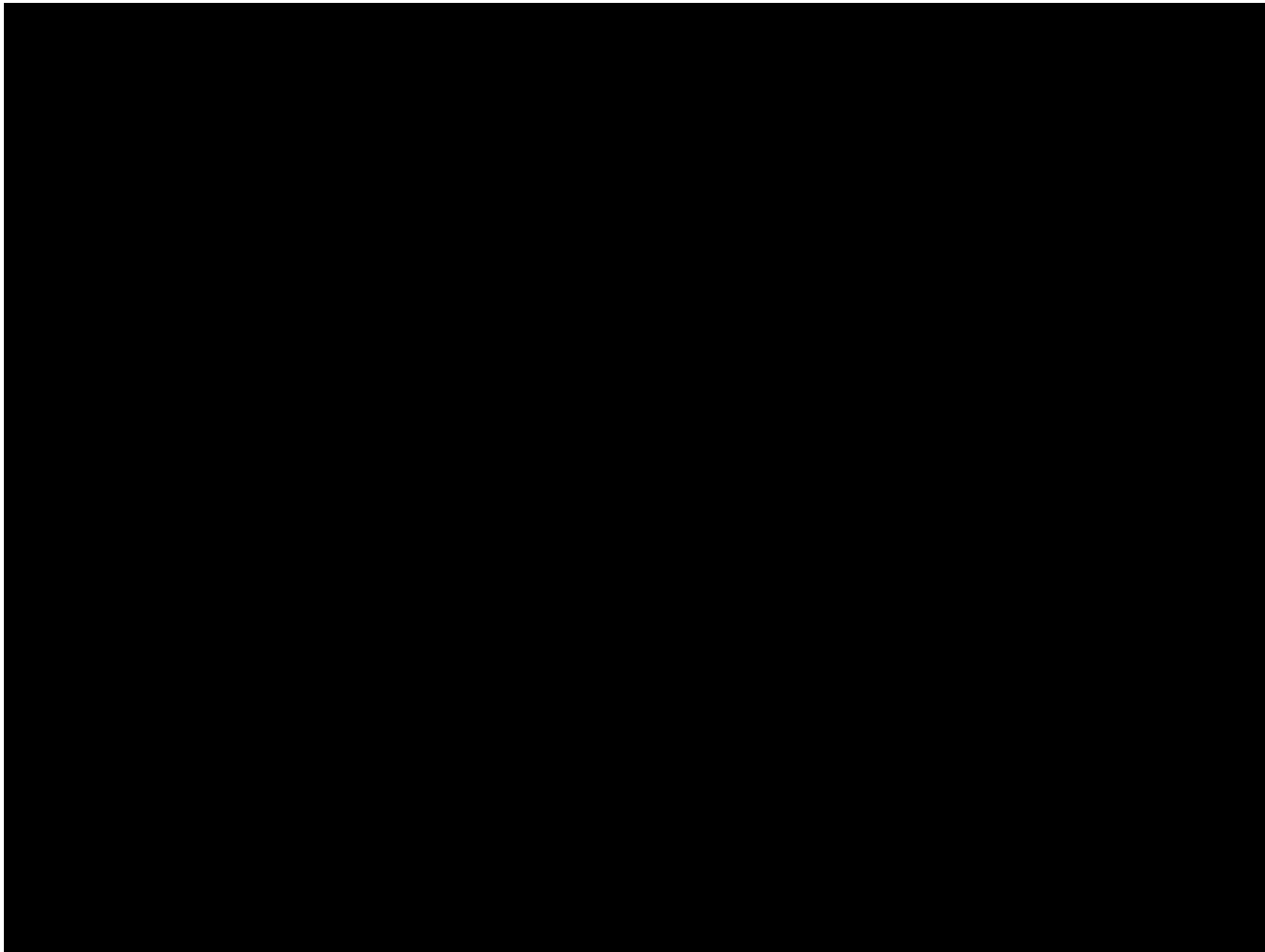
Hybrid world



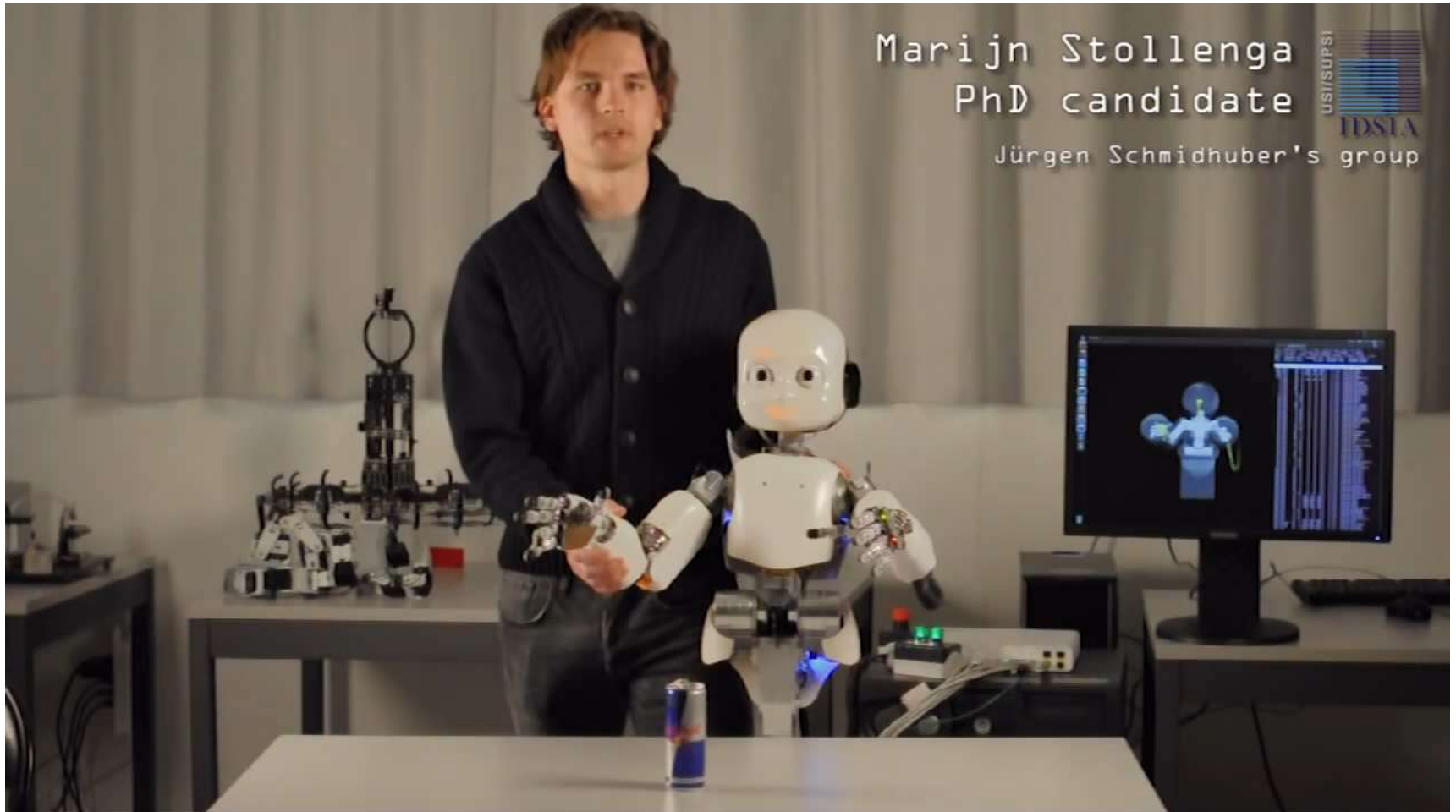
A new hybrid word



**... art. Teatro Dimitri. Lugano,
Performance CIRP, 2017**



Learning to manipulate

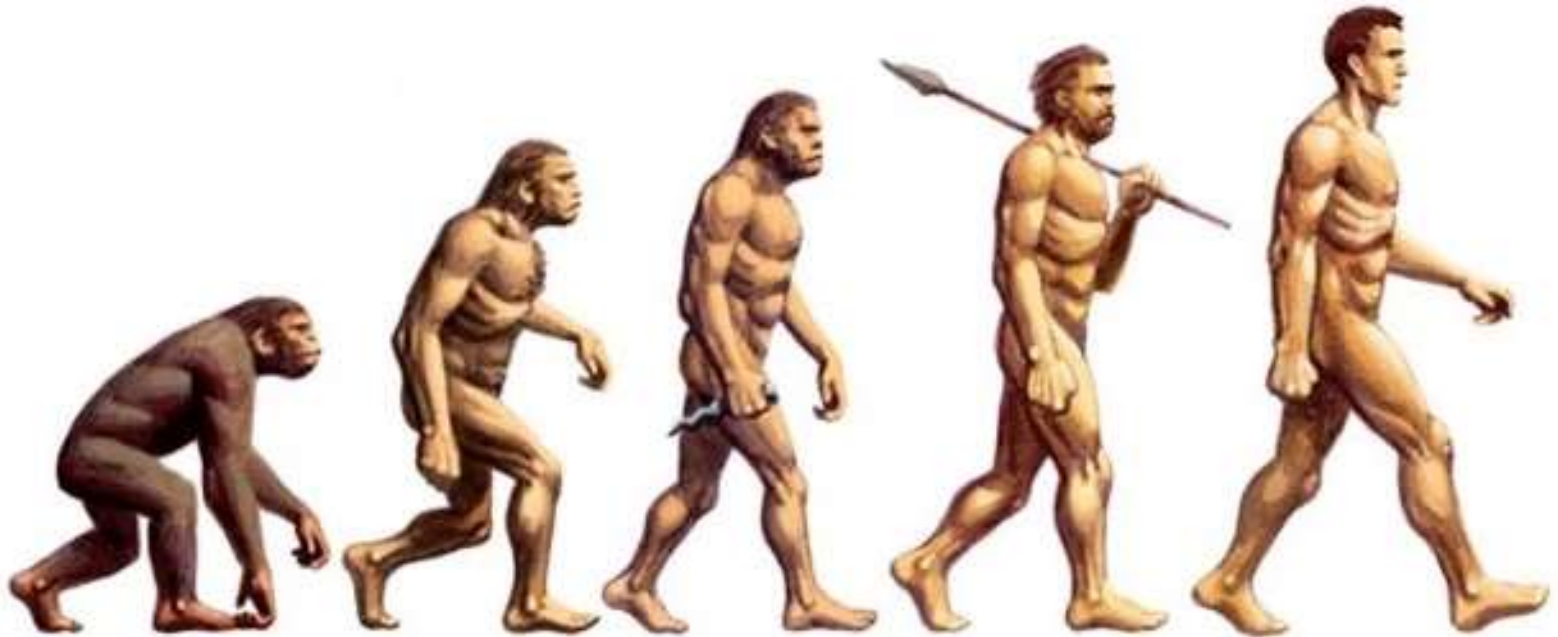


BY ANA MARIA MONTERO @AMMONTEROCNN | 5 November 2018

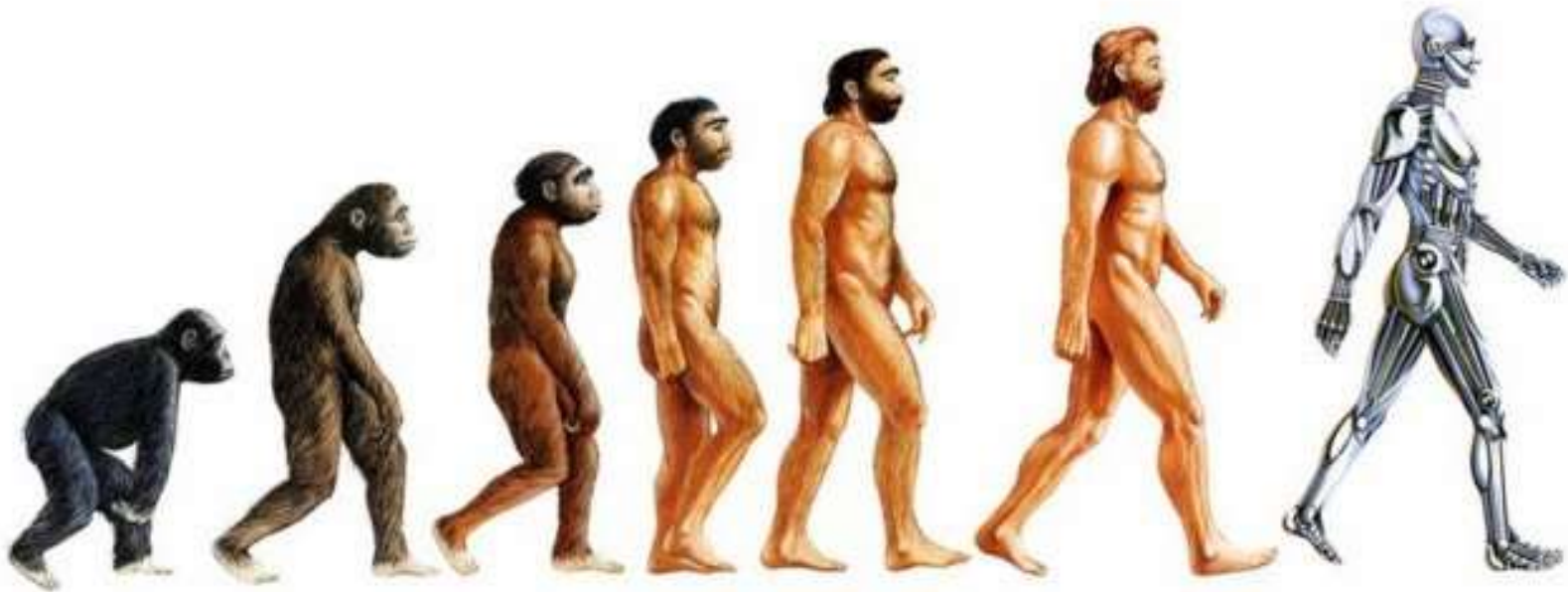
U.S. AND SWITZERLAND EXPLORE DEALS ON DRONES



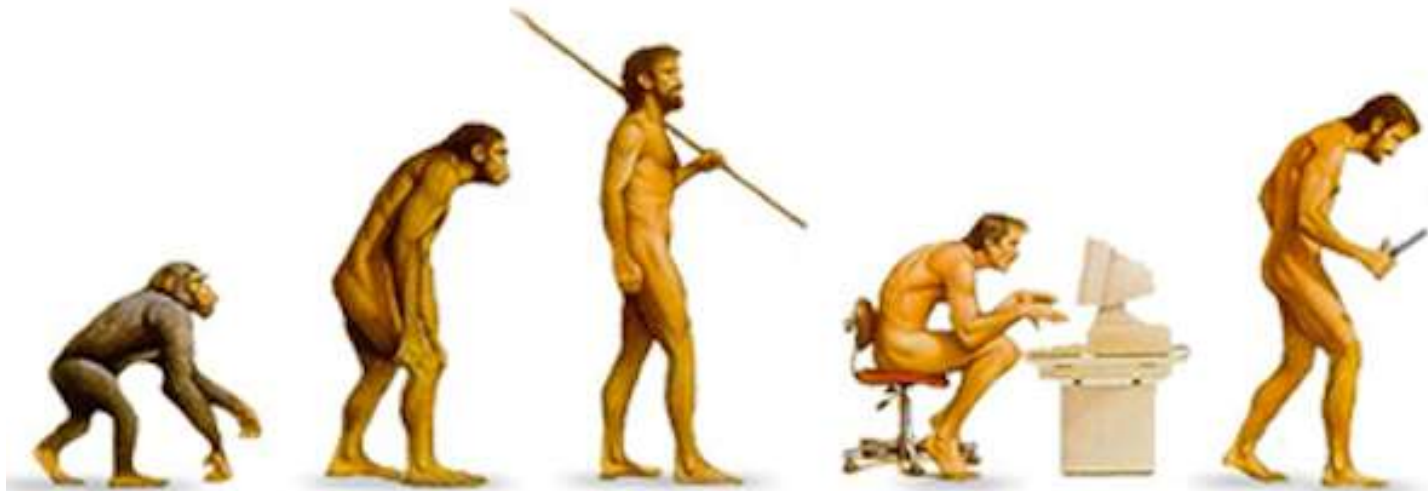
Species Evolution



Species Evolution



A new hybrid world is coming



A new hybrid world is coming



... in the new hybrid world

Professionals who use AI as a quick and effective consultant who can provide them with opinions, scenarios and advice.

But human must remain at the center of the decision-making process, so..... please, on the one hand AI... but keep shaking hands with your clients on the other.



Master of Science
in Artificial Intelligence:
Be part of the AI
revolution.

Università
della
Svizzera
italiana

Facoltà
di scienze
informatiche

"65% of the kids in
preschool today will work
in jobs or careers that dont
yet exist"



Whether I've got an audience of
3,000 people in Vegas, or a small
CEO-level meeting of 20 people, I
always open with the same
observation.



It's from an Australian study which
concluded that 65% of the kids in
pre-school today will work in jobs or
careers that do not yet exist.

I then challenge people to think through the global trends at work which are
making such a bold statement into a reality. And I often walk through the types of
new careers that are emerging in every industry to emphasize the point.

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www.mai.usi.ch

some important questions



Università
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Italiana

Master in Philosophy



Title: Philosophy and Artificial Intelligence

Abstract:

Artificial Intelligence, abbreviated as AI, is the subfield of Computer Science devoted to developing programs that enable computers to display behavior that can (broadly) be characterised as intelligent. According to its strong version, its ultimate goal should be to create an artificial system that is as intelligent as a human being. Recent striking success such as AlphaGo have indeed made the public believe that not only this objective is possible, but that in a not so far future machines could be even more intelligent than human beings.

The actual and possible developments of artificial intelligence open up a series of striking questions such as:

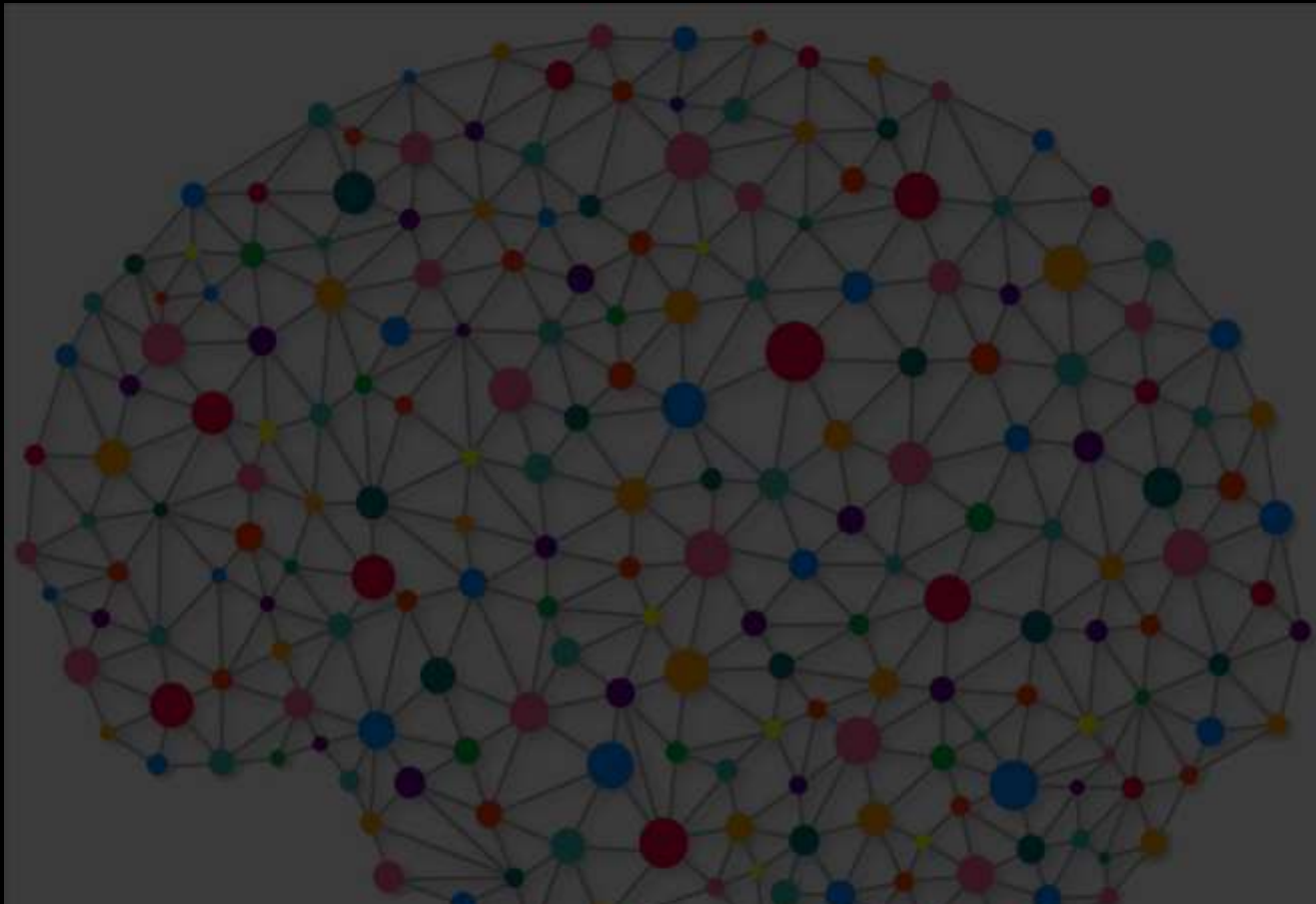
- Can really a computer think in the way a human being does?
- Is the human brain and mind a computer?
- Can a computer have a mind and conscious experiences, such as thoughts, desires, and emotions?
- What is artificial intelligence? Is it the same as human intelligence? Are they even comparable or are they something essentially different?
- Can a machine be morally responsible for its actions? Can a machine be good or evil? What other moral considerations are related to AI?

The aim of this course is to tackle such questions and discuss them in the context of the historical development of AI.

Teachers:

Alessandro Facchini, Barry Smith

The vision: a huge
interactive AI installation
(inside the artificial brain)



Tunnel pedonale Lugano-Besso



NeuralRope#1. Inside an Artificial Brain.

di Alex Dorici
e Luca Maria Gambardella

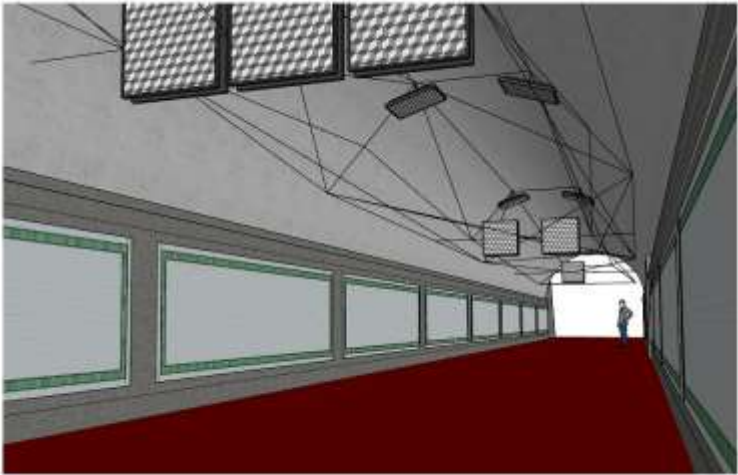
Tunnel pedonale Lugano-Besso (below the train station)

a kinship between artistic work and scientific research to better understand what AI is

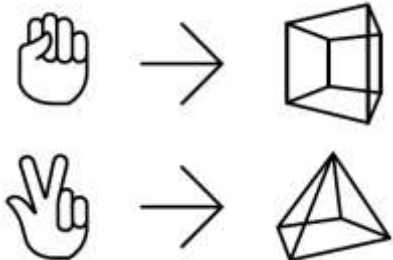


NeuralRope#1. Inside an Artificial Brain

An interactive urban installation reproducing an Artificial Neural Networks where the **eye** is a camera, **neural connections** are 700m of florescent ropes and **neurons** are 16 LED screens showing in real time the NN activities.



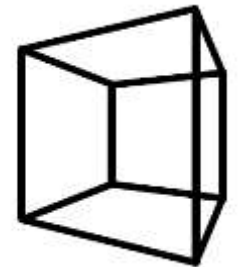
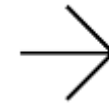
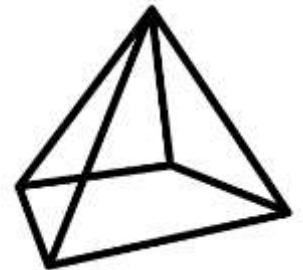
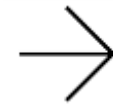
Alex Dorici, visual artist who creates art installations with naval ropes based on cubical and pyramidal forms



We trained **NeuralRope#1** in the tunnel by recording the hand gestures of 15 volunteers from the camera.

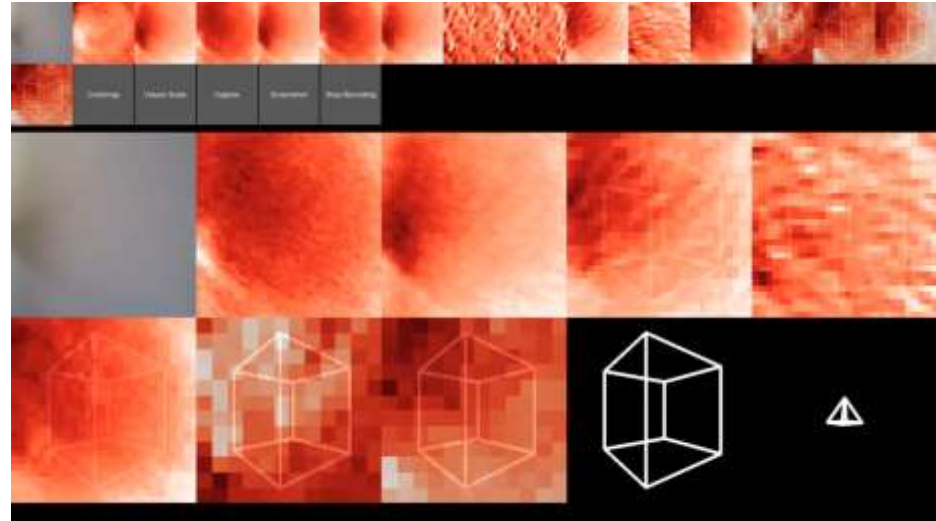
(approx. 3,000 images in two minutes, tot. 30 min, 45,000 images)

... we associated the cube with the fist and the pyramid with the three fingers to remember the work of **Alex Dorici**





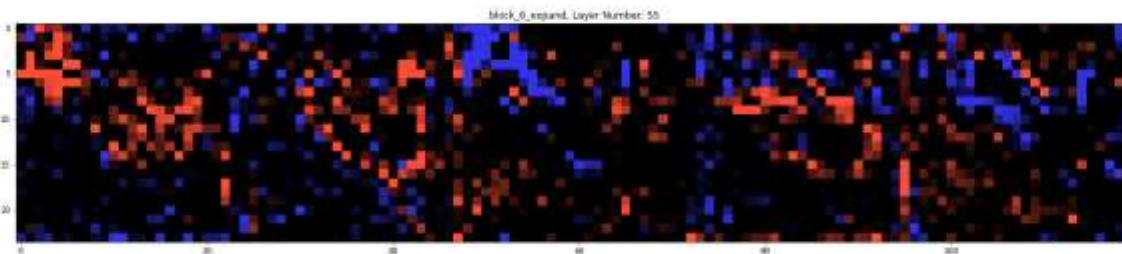
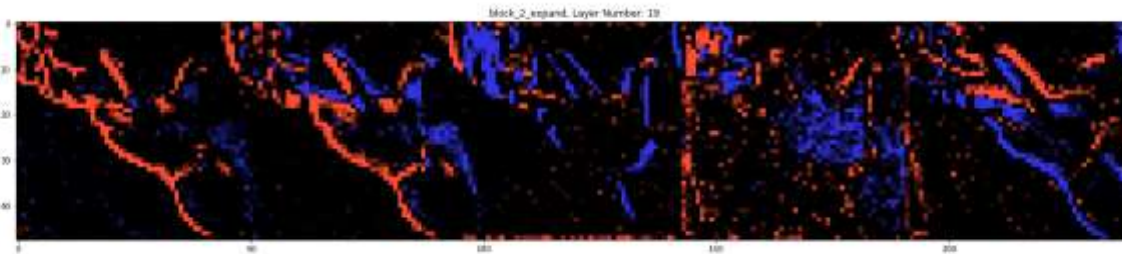
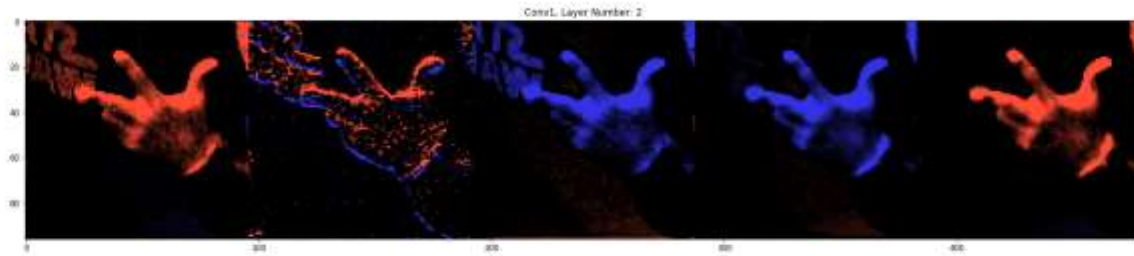
In case you visit the Besso tunnel,
please:
stop in the footsteps and
make gestures on the camera.



NeuralRope#1 tries to recognize it:
in case of fist it shows a cube
in case of three fingers a pyramid
.... and more secret gestures!

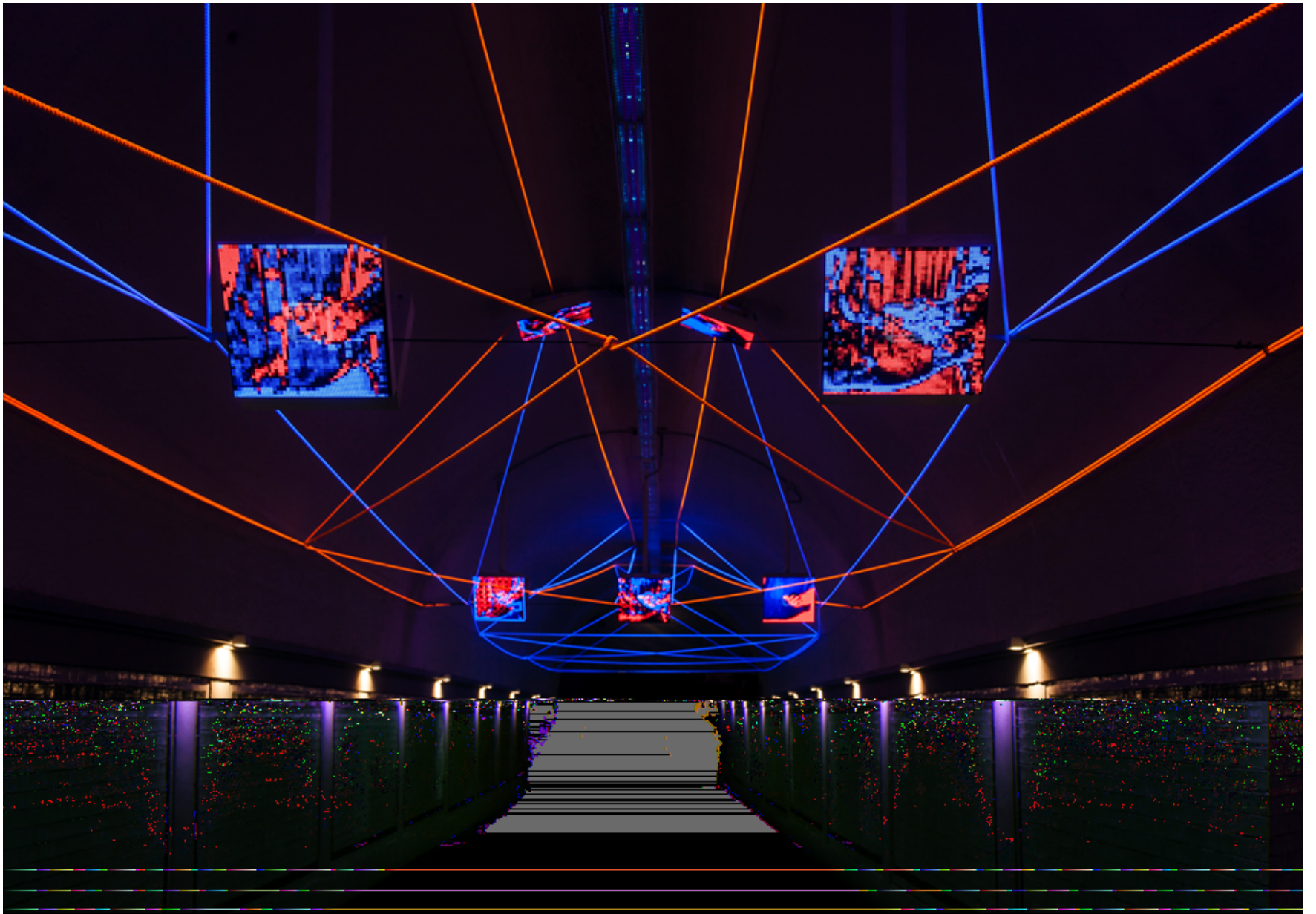


NeuralRope#1 internal neurons states visualized in real time on the 16 led screens



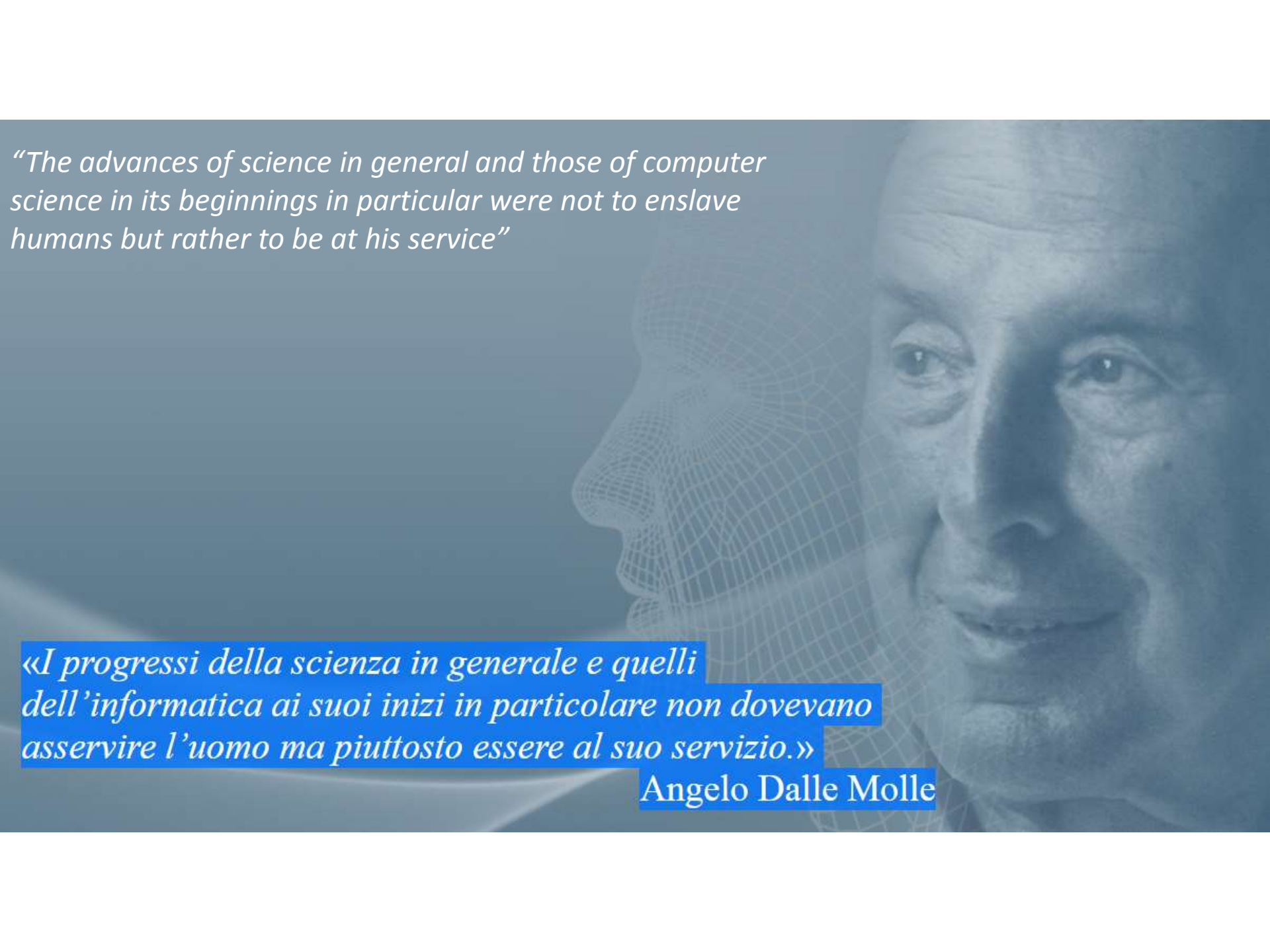






... a greeting for you with a special gesture at the end of the video !





“The advances of science in general and those of computer science in its beginnings in particular were not to enslave humans but rather to be at his service”

«I progressi della scienza in generale e quelli dell'informatica ai suoi inizi in particolare non dovevano asservire l'uomo ma piuttosto essere al suo servizio.»

Angelo Dalle Molle

Scuola universitaria professionale
della Svizzera italiana.

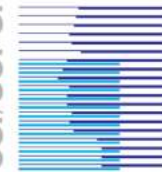
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Thank you for your attention



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