Innovation through Artificial Intelligence

ZHAW
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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 academia since 2012
China Is Quickly Becoming an AI Superpower

- Peter H. Diamond, 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.”
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.
IDSIA is a research institute on Artificial Intelligence founded in 1988 in Lugano

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

IDSIA is a common USI and SUPSI since 2000

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

«Die Fortschritte der Wissenschaft im Allgemeinen und die der aufstrebenden Informatik im Besonderen den Menschen nicht unterwerfen, sondern ihm nützen sollten.»
2.0M - 100 papers x year

Machine Learning – Deep NN
Swarm Optimization - Robotics

2.0M – 15-20 running projects
What is AI today?
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
MAV Navigation in the Forests
Trail Following under the Tree Canopy

IDSIA, Lugano, Switzerland
RPG, University of Zurich, Switzerland

NCCR Robotics subproject 4.7
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
Google voice search: faster and more accurate

Posted: Thursday, September 24, 2015

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 /i/ 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.
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

Data — Program — Output

Data — Output — Program
Some applications
Novartis
(Basel)
DXT Commodities (Lugano)
Energy markets

Trading of energy and optimisation of wind & solar plants
Corriere del Ticino (Lugano)
Profiling readers
Personalised ads and news
C-Labs & SGS
(Manno, Geneve)
Intelligent text mining
Georg Fischer
(Losone)
self learning machining

MACHINE OPERATOR

Operator feedback field
- Real-time data acquisition
- Process output results

Operator application field
- Basic process parameters
- Protection algorithms

VIOLA
Virtual Operator with self-Learning Algorithm

KNOWLEDGE BASE EXPERT SYSTEM
Fusion rule

DATA MINING
(From experimental results)

EXPERT KNOWLEDGE
(Specialists at GFMS)

KTI/CTI
inspire
Casale sa
(Lugano)
Industry: Predictive maintenance

Predictive maintenance, failure detection and distance process analytics

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

AI-CARES
Armasuisse
(Thun)
Strategic Expert System
UBS
(Zürich, Manno)
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?

“...what we want is a machine that can learn from experience.”
Alan Turing, 1947

If you torture the data long enough, it will confess to anything.
Ronald Coase
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 what 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

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

DOMAIN KNOWLEDGE & SOFT SKILLS
- Passionate about the business
- Curious about data
- Influence without authority
- Hacker mindset
- Problem solver
- Strategic, proactive, creative, innovative and collaborative

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
The prize is the new NVIDIA DGX-1 Deep Learning Supercomputer valued at 130’000$
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.
Swiss National Centre of Competence in Research
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
Hybrid world

Patent pending
A new hybrid word
… art. Teatro Dimitri. Lugano, Performance CIRP, 2017
Learning to manipulate
U.S. AND SWITZERLAND EXPLORE DEALS ON DRONES
Species Evolution
A new hybrid world is coming
A new hybrid world is coming
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.
"65% of the kids in preschool today will work in jobs or careers that don't 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.
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
Thank you for your attention