Big Data and A.I.
-Ethical and societal implications-

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January 28, 2019
Data as an Economic and Semantic Asset

“I think we’re just beginning to grapple with implications of data as an economic asset” (*)


- Data has become a new economic asset.
- The companies with big data pools can have great economic power
- They greatly influence what the philosopher Floridi call our semantic capital (**)
What is more important, vast data pools, sophisticated algorithms or deep pockets?

“No one can replicate your data. It’s the defensible barrier, not algorithms.” (*)

-- Andrew Ng, Stanford professor

(*) Source: Big Data and The Great A.I. Awakening. Interview with Steve Lohr, ODBMS Industry Watch, December 19, 2016
“AI is akin to building a rocket ship. You need a huge engine and a lot of fuel. The rocket engine is the learning algorithms but the fuel is the huge amounts of data we can feed to these algorithms.” (*)

-- Andrew Ng

It is important to note that Big Data is of NO use unless it is analysed.

(*) Source: Big Data and The Great A.I. Awakening. Interview with Steve Lohr, ODBMS Industry Watch, December 19, 2016
The Big Data revolution and the new developments in Hardware have made the recent AI advances possible.

“The initial use of Big Data technologies started with Marketing. One stage in the life cycle of an emerging science, marketing is a low-risk – and, yes, lucrative.” (*)

“In marketing and advertising, a decision that is better on average is plenty good enough. You’ve increased sales and made more money. You don’t really have to know why.” (*)


(*) Source: Big Data and The Great A.I. Awakening, Interview with Steve Lohr, ODBMS Industry Watch, December 19, 2016
AI and Big Data for higher-stakes decisions

- Technology is moving beyond increasing the odds of making a sale, to being used in higher-stakes decisions like medical diagnosis, loan approvals, hiring and crime prevention...
“...our application of mobile and sensor technology to monitor symptoms, disease progression and treatment response – the so called “Digital Biomarkers”. We have our most advanced programmes in Multiple Sclerosis (MS) and Parkinson`s Disease (PD), with several more in development. Using these tools, a longitudinal real-world profile is built that, in these complex syndromes, helps us to identify signals and changes in symptoms or general living factors, which may have several potential benefits.” (*)

— Bryn Roberts
Global Head of Operations for Roche Pharmaceutical Research & Early Development

(*) Source: On using AI and Data Analytics in Pharmaceutical Research. Interview with Bryn Roberts ODBMS Industry Watch, September 10, 2018
"I’m intrigued by the general trend towards empowering individuals to share their data in a secure and controlled environment. **Democratisation of data** in this way has to be the future. Imagine what we will be able to do in decades to come, when individuals have access to their complete healthcare records in electronic form, paired with high quality data from genomics, epigenetics, microbiome, imaging, activity and lifestyle profiles, etc., supported by a platform that enables individuals to share all or parts of their data with partners of their choice, for purposes they care about, in return for services they value – very exciting! “

— Bryn Roberts

(*) Source: On using AI and Data Analytics in Pharmaceutical Research. Interview with Bryn Roberts ODBMS Industry Watch, September 10, 2018
Example: Transportation: Railigent

- Transportation is using a lot of AI-driven algorithms.

- Railigent is a cloud based platform, by Siemens, designed to help rail operators and rail asset owners, to improve fleet availability and improve operations, for example by enabling intelligent data gathering, monitoring, and analysis for prescriptive maintenance in the rail transport industry.

- Railigent contains a cloud based platform layer to support ingest and storage of large and diverse data sets, high end data analytics and applications. This layer is open, both for customers and partners.

- On top of this layer, Railigent provides a large set of applications for monitoring and analyzing rail assets. Also here applications and components can be provided by partners or customers. Target is to help customers improve fleet availability and improve operations.

Source: On AI and Data Technology Innovation in the Rail Industry. Interview with Gerhard Kress ODBMS Industry Watch, 2018-07-31
Automate or Augment humans?

- You can use AI technologies either to automate or to augment humans.

In the first case, machines replace people, in the second case machine complements people (at least in theory).
Implications

When we use Big Data in domains such as healthcare, decisions are practically and ethically very different than marketing and advertising.

These are crucial decisions about individual people’s lives. Better on average isn’t good enough.

For these kinds of decisions, issues of accuracy, fairness and discrimination come into play.
Some AI applications may raise new ethical and legal questions, for example related to liability or potentially biased decision-making.

For example, algorithms are used to review loan applications, recruit new employees and assess potential customers, and if the data are skewed the decisions recommended by such algorithms may be discriminatory against certain categories or groups.
Example: Healthcare Predictive Insights

“What happens if my algorithm is wrong? Someone sees the wrong ad. What’s the harm? It’s not a false positive for breast cancer.” (*)

-- Claudia Perlich, Data Scientist

(*) Source: Big Data and The Great A.I. Awakening, Interview with Steve Lohr ODBMS Industry Watch, December 19, 2016
“Citizens and businesses alike need to be able to trust the technology they interact with, and have effective safeguards protecting fundamental rights and freedoms.

In order to increase transparency and minimise the risk of bias, AI systems should be developed and deployed in a manner that allows humans to understand the basis of their actions.

Explainable AI is an essential factor in the process of strengthening people’s trust in such systems.” (*)

-- Roberto Viola
Director General of DG CONNECT (Directorate General of Communication Networks, Content and Technology) at the European Commission.

(*) Source On the Future of AI in Europe. Interview with Roberto Viola, ODBMS Industry Watch2018-10-09
Who is responsible?

“I think the most important aspect of this question is the simple acknowledgement that intelligent system designers do have ethical responsibilities.” (*)


“We have a profound ethical responsibility to design systems that have a positive impact on society, obey the law, and adhere to our highest ethical standards.” (**)

–Oren Etzioni
Chief Executive Officer Allen Institute for Artificial Intelligence.

(*) Source: Machines of Loving Grace. Interview with John Markoff. ODBMS Industry Watch, August 11, 2016
(**) Source: On Artificial Intelligence and Society. Interview with Oren Etzioni, ODBMS Industry Watch, January 15, 2016
“We are moving towards changes in how ethics has to be perceived: away from individual decisions with specific and knowable outcomes, towards actions by many unaware that they may have taken actions with unintended consequences for anyone.”

--Andrej Zwitter (Dean Faculty Campus Fryslân / Prof. of Governance and Innovation)
As Norbert Walter wrote: (*)

“Ethics is dependent on the homogeneity of society and functioning sanctions against the non-compliance of the rules”.

“I think ethical software development for AI is not fundamentally different from ethical software development in general. The interesting new question is: when AIs learn by themselves, how do we keep them from going astray?

Fixed rules of ethics, like Asimov’s three laws of robotics, are too rigid and fail easily. (That’s what his robot stories were about.) But if we just let machines learn ethics by observing and emulating us, they will learn to do lots of unethical things.

So maybe AI will force us to confront what we really mean by ethics before we can decide how we want AIs to be ethical.” (*)

--Pedro Domingos (Professor at University of Washington)

(*) Source: On Artificial Intelligence, Machine Learning, and Deep Learning. Interview with Pedro Domingos, ODBMS Industry Watch, June 18, 2018
UK Select Committee on Artificial Intelligence
5 core principles to keep AI ethical

- AI must be a force for good - and diversity
- Intelligibility and fairness
- Data protection
- Flourishing alongside AI
- Confronting the power to destroy

Source: World Economic Forum
What if the decision made using AI-driven algorithm harmed somebody, and you cannot explain how the decision was made?

At present we do not really understand how Advanced AI-techniques such as used in Deep learning (e.g. neural networks) really works. It can be extremely difficult to understand which features of the data the machine used, and how they were weighted, to contribute to the outcome.

This is due to the technical complexity of such advanced neural networks, which need huge amount of data to learn properly. It is a try and error.

This poses an ethical and societal problem.
“Since the algorithms learn from data, it’s not as easy to understand what they do as it would be if they were programmed by us, like traditional algorithms. But that’s the essence of machine learning: that it can go beyond our knowledge to discover new things. A phenomenon may be more complex than a human can understand, but not more complex than a computer can understand.

And in many cases we also don’t know what humans do: for example, we know how to drive a car, but we don’t know how to program a car to drive itself. But with machine learning the car can learn to drive by watching video of humans drive.” (*)

--- Pedro Domingos

(*) Source: On Artificial Intelligence, Machine Learning, and Deep Learning. Interview with Pedro Domingos, ODBMS Industry Watch, June 18, 2018
Debugging an AI

“Debugging an AI is more like domesticating an animal than debugging a program.”

“Debugging AI systems is harder than debugging traditional ones, but not impossible. Mainly it requires a different mindset, that allows for non-determinism and a partial understanding of what’s going on. Is the problem in the data, the system, or in how the system is being applied to the data?” (*)

-- Pedro Domingos

(*) Source: On Artificial Intelligence, Machine Learning, and Deep Learning. Interview with Pedro Domingos, ODBMS Industry Watch, June 18, 2018
“I would have welcomed to see a slide with a focus on the need for diversity in AI research and development teams, as this has direct impact on ethical considerations regarding AI/ML systems. If AI/ML teams are too homogeneous, the likelihood of group-think and one-dimensional perspectives rises – thereby increasing the risk of leaving the whole AI/ML project vulnerable to inherent biases and unwanted discrimination.” (*) -- Nicolai Pogadl

(*) Source: personal communication.
Is it essential to keep a human in the loop?

If not, do you run the risk of abdicating ethical responsibility for system design?

Is it realistic? If something can be partially automated, will it eventually be fully automated?
Let's consider an autonomous car that relies entirely on an algorithm that had taught itself to drive by watching a human do it.

What if one day the car crashed into a tree, or even worse killed a pedestrian?
This is referred in the literature as the *crash assignment*, especially between automated vehicles and non automated vehicles.

Some researchers have indicated that automated vehicles will need to be programmed with some sort of ethical system in order to make decisions on how to crash. We will come back to this point later when we talk about *Ethics by Design*. 
Few studies however, have been conducted on how particular ethical theories will actually make crash decisions and how these ethical paradigms will affect automated vehicle programming. [Wesley 2015]
“If the learning took place before the car was delivered to the customer, the car’s manufacturer would be liable, just as with any other machinery. The more interesting problem is if the car learned from its driver. Did the driver set a bad example, or did the car not learn properly?”

--Pedro Domingos

(*) Source: On Artificial Intelligence, Machine Learning, and Deep Learning. Interview with Pedro Domingos, ODBMS Industry Watch, June 18, 2018
In the area of autonomous vehicle, there are initiatives to define Ethical principles, spanning from independent associations such as:

The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems, which aims [IEEE 2018]:

“To ensure every stakeholder involved in the design and development of autonomous and intelligent systems is educated, trained, and empowered to prioritize ethical considerations so that these technologies are advanced for the benefit of humanity”

Source: https://standards.ieee.org/develop/indconn/ec/autonomous_systems.html
…to political bodies such as the German Ethics Commission on Automated Driving.

“The Ethics Commission on Automated and Connected Driving has developed initial guidelines for policymakers and lawmakers that will make it possible to approve automated driving systems but that set out special requirements in terms of safety, human dignity, personal freedom of choice and data autonomy.”

-- Prof. Di Fabio


The Ethics Commission's complete report can be found here: [www.bmvi.de/report-ethicscommission](http://www.bmvi.de/report-ethicscommission)
The Ethics Commission's report comprises 20 propositions.

The key elements are: (from the web site: https://www.bmvi.de/SharedDocs/EN/PressRelease/2017/084-ethic-commission-report-automated-driving.html)

- Automated and connected driving is an ethical imperative if the systems cause fewer accidents than human drivers (positive balance of risk).
- Damage to property must take precedence over personal injury. In hazardous situations, the protection of human life must always have top priority.
- In the event of unavoidable accident situations, any distinction between individuals based on personal features (age, gender, physical or mental constitution) is impermissible.
- In every driving situation, it must be clearly regulated and apparent who is responsible for the driving task: the human or the computer.
- It must be documented and stored who is driving (to resolve possible issues of liability, among other things).
- Drivers must always be able to decide themselves whether their vehicle data are to be forwarded and used (data sovereignty).
Causality— in other words, grasping not just patterns in data but why something happens. Why is that important, and why is it so hard?

“If you have a good causal model of the world you are dealing with, you can generalize even in unfamiliar situations. That’s crucial. We humans are able to project ourselves into situations that are very different from our day-to-day experience. Machines are not, because they don’t have these causal models.

We can hand-craft them, but that’s not enough. We need machines that can discover causal models. To some extent it’s never going to be perfect. We don’t have a perfect causal model of the reality; that’s why we make a lot of mistakes. But we are much better off at doing this than other animals.

Right now, we don’t really have good algorithms for this, but I think if enough people work at it and consider it important, we will make advances.”

--Yoshua Bengio

(*) Source MIT Technology Review
Waymo created a Recurrent Neural Network (RNN) for Driving.

They trained the neural network Imitating the “**Good**” and synthesizing the “**Bad**”.

“Knowing **why** an expert driver behaved the way they did and what they were reacting to is critical to building a causal model of driving. For this reason, simply having a large number of expert demonstrations to imitate is not enough. **Understanding the why** makes it easier to know how to improve such a system, which is particularly important for safety-critical applications.” (*)

However, I do not believe that we know WHY and HOW we drive though…

Try for yourselves: Explain to another person how do you drive and why you react in certain situations they way you do….. And please let me know the result.

(*) Source: Learning to Drive: Beyond Pure Imitation
https://medium.com/waymo/learning-to-drive-beyond-pure-imitation-465499fc04b2

ChauffeurNet: Learning to Drive by Imitating the Best and Synthesizing the Worst. Mayank Bansal, Alex Krizhevsky, Abhijit Ogale
Are computer system designers (i.e. Software Developers, Software Engineers, Data Scientists, Data Engineers, and their Managers…), the ones who will decide what the impact of these technologies are and whether to replace or augment humans in society?
Do we need some sort of auditing tool?
The technology has to be able to “explain” itself, to explain how a data-driven algorithm came to the decision or recommendation that it did. Is it technically feasible? This is current research work area.

How much Transparency is desired/ possible?

Do we wish “Human in the loop” for most of these kinds of decisions for the foreseeable future?
A recent study out of North Carolina State University found that asking software engineers to read a code of ethics does nothing to change their behaviour. (*)

How is it possible to define incentives for using an ethical approach to software development, especially in the area of AI?

(*) Source: https://people.engr.ncsu.edu/ermurph3/papers/fse18nier.pdf
“Solving actual moral problems is not simply a matter of choosing the "best" of several possible responses. It is also a matter of devising possible responses. Design practice in engineering affords important lessons about addressing practical problems” [Whitbeck 1996]
Ethics inside

Can **Ethics** be "embedded" into the core of the **AI** design?

Not reacting to it....

Kind of "Ethics inside".
Data, AI and Intelligent systems are becoming sophisticated tools in the hands of a variety of stakeholders, including political leaders.
“It is absolutely essential that we control the machines, and every indication is that we will be able to do so in the foreseeable future. I do worry about human motivations too. Someone said: I’m not worried about robots deciding to kill people, I’m worried about politicians deciding robots should kill people.” (*)

-- Oren Etzioni

(*) Source: On Artificial Intelligence and Society. Interview with Oren Etzioni, ODBMS Industry Watch, January 15, 2016
“Good data reflects reality and thus can help us gain insights into how the world works. That does not make such discovery ethical, even though the discover is correct.

Good intentions point towards an ethical use of data, which helps protect us again unethical data uses, but does not prevent false big data analysis.

This is a long way of saying we need both, albeit for different reasons.” (*)

--Viktor Mayer-Schönberger, Professor of Internet Governance and Regulation at Oxford University (UK).

And we have Bad Intentions as well…..

The thing that **motivates** my **actions** will determine the **direction** I am going.
The individual and collective conscience is the existential place where the most significant things happen.

Research, Change, Decision and Choice can take two diametrically opposite directions:

can be either “pro or contra” the human person”. (*)

Source: "The good society and the future of jobs: Can solidarity and fraternity be part of business decisions?" MAY 8 -10, 2014 – Vatican City
“Data for Humanity”

An initiative I started with Andrej Zwitter (Professor at the University of Groningen) at the end of 2015, with the goal to:

bring people and institutions together who share the motivation to use data for the common good.

which calls for the use of five ethical principles for the use of data- has reached more than 1,000 signatories worldwide.

www.bigdata.uni-frankfurt.de/dataforhumanity/
Five ethical principles when using data

- Do no harm
- Use data to help create peaceful coexistence
- Use data to help vulnerable people and people in need
- Use data to preserve and improve natural environment
- Use data to help create a fair world without discrimination
Do we need to regulate the development of artificial intelligence?

“While self-regulation can be a first stage in applying an ethical approach, public authorities must ensure that the regulatory framework that applies to AI technologies is fit for purpose and in line with our values and fundamental rights.

For example, the Commission is currently assessing the safety and national and EU liability frameworks in light of the new challenges, and we will examine whether any legislative changes are required.” (*)

-- Roberto Viola
Director General of DG CONNECT (Directorate General of Communication Networks, Content and Technology) at the European Commission.

(*) Source On the Future of AI in Europe, Interview with Roberto Viola, ODBMS Industry Watch2018-10-09
“The Commission closely monitors all relevant developments related to AI and, if necessary, we will review our existing legal framework. The EU has a strong and balanced regulatory framework to build on in order to develop a sustainable approach to AI technologies. This includes high standards in terms of safety and product liability, EU-wide rules on network and information systems security and stronger protection of personal data that came into force in May 2018.” (*)

--Roberto Viola

(*) Source On the Future of AI in Europe. Interview with Roberto Viola, ODBMS Industry Watch 2018-10-09
EU: Ethics Guidelines for Trustworthy AI


This working document was produced by the European Commission’s High-Level Expert Group on Artificial Intelligence (AI HLEG). The final version is due in March 2019.
Regulations vs. Innovation

“I think the biggest challenge is that in the rail business we have a very large set of old and country specific regulations that date back many decades. These regulations are meant to protect passengers, but some of them are not anymore fitting to the modern capabilities of technology and instead drive cost and slow innovation down dramatically.” (*)

-- Gerhard Kress (Director Mobility Data Services Siemens)

(*) Source: On AI and Data Technology Innovation in the Rail Industry. Interview with Gerhard Kress, ODBMS Industry Watch, July 31, 2018
“Robust [and standardized?] procedures for testing and validating AIs would be a pragmatic solution, even if we don’t understand fully the heuristics. Perhaps, by extensive testing with actual or synthetic data sets and extreme scenarios, an AI could be validated for its intended purpose, including likely paths of future learning?” (*) --Bryn Roberts

Perhaps we can “certify” AIs by the number of testing with synthetics data sets and extreme scenario they went through before allowing AIs to drive a car (similar to what happens to airplane pilots). Somebody would need to define when good is enough. And this may be tricky…

More feedback I have received, and resources here:
What I am not covering in this presentation...

“In Defense, AI used in conjunction with offensive weapons will change warfare.

Is the behavior of the autonomous system proportionate?

This particularly concerns proper discrimination (combatant vs. non-combatant).

Even for man, discriminating between a combatant and a civilian is difficult, because in modern conflicts combatants are no longer distinguishable from civilians. Many warring adversaries are not recognizable as fighters/soldiers because civil dressed.

The decision as to which an autonomous machine’s behavior is legitimate therefore needs to be made using CONTEXT. When making a similar decision, man would rely on concepts such as “good faith” or sensus communis. The philosopher Markus Gabriel speaks of the “unified impression” people have on everyday life.

This is not comparable to the data salad an autonomous machine needs to fuse into a picture of a situation. Thus, with the requirement of proportionality, the question arises: Will an autonomous machine “think” like man? (*)

– Yvonne Hofstetter

(*) Source: personal communication.
Are we talking about Science Fiction here or...

“The ideal of General AI is that the system would possess the cognitive abilities and general experiential understanding of its environments that we humans possess, coupled with the ability to process this data at much greater speeds than mortals. It follows that the system would then become exponentially greater than humans in the areas of knowledge, cognitive ability and processing speed – giving rise to a very interesting species-defining moment in which the human species are surpassed by this (now very) strong AI entity.”

Source: https://hackernoon.com/general-vs-narrow-ai-3d0d02ef3e28

and this poses severe Ethical concerns....

I also believe that AI initiative such as Neuralink: https://www.neuralink.com/ poses serious Ethical issues...

"Creating a neural lace is the thing that really matters for humanity to achieve symbiosis with machines" (*)

-- Elon Musk

(*) Source: https://twitter.com/elonmusk/status/739006012749799424

"Brain-computer interfaces could change the way people think, soldiers fight and Alzheimer’s is treated. But are we in control of the ethical ramifications? "(**)

(**) Source: https://www.theguardian.com/technology/2018/jan/01/elon-musk-neurotechnology-human-enhancement-brain-computer-interfaces
People motivation plays a key role here. With AI the important question is how to avoid that it goes out of control, and how to understand how decisions are made.

What I am interested in (no particular order):

- Raise awareness;

- Help create and support best practices holistic “Ethics Labs”;

- Talk to AI developers, learn how Ethics can be “embedded” into the core of the AI design;

- Learn what measures have to be taken for achieving a trustful AI;

- Write a book on AI and Ethics for the general public.
AI vision for the future

“It should be all of us. Right now it is mainly the companies that have lots of data and sophisticated machine learning systems, but all of us – as citizens and professionals and in our personal lives – should become aware of what AI is and what we can do with it.

How can I use AI to do my job better, to find the things I need, to build a better society?

Just like driving a car does not require knowing how the engine works, but it does require knowing how to use the steering wheel and pedals, everyone needs to know how to control an AI system, and to have AIs that work for them and not for others, just like they have cars and TVs that work for them.” (*)

-- Pedro Domingos

(*) Source: On Artificial Intelligence, Machine Learning, and Deep Learning. Interview with Pedro Domingos. CUBNIS Industry Watch, June 18, 2018