Limits of the current state of Artificial Intelligence for Law

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Outline

• Quick introduction to AI and Science
• AI, a hot trend in today’s business
• Demonstration of few AI systems
• Why AI cannot serve Law real challenges yet?
• Further reading
Quick introduction to AI
What do natural sciences do? (...and AI is just a part of natural sciences)

• Nature is organized in structures which are mostly self-similar
  • ...structures look like crystals

• Science tries to uncover hidden structures in nature
  • ...it doesn’t discover something new, it is rather uncovering what is out there, already existing
How science describes the nature?

• Science developed formalisms (languages) to describe structures in nature
  • ...usually, these are mathematical formulas
  • ...if we graphically represent formulas, the structures look similar to the ones in nature
  • Most popular formalisms in science are algebra and logic – they nicely correspond to the basic building blocks in nature
What AI can and cannot do today?

• Artificial Intelligence is a collection of more or less simple building blocks (like LEGO bricks) which we compose in more complex structures
  • ...such structures correspond to problems in nature and allow solving problems

• Example of problems which are solvable today:
  • Speech recognition from audio
  • Object and face recognition from images
  • Machine translation
  • Machine Learning from data
  • Simple forms of reasoning

• But, AI cannot do:
  • Understanding semantics of text, since language has too complex structure
  • Learning from its own experience
Structure of AI and its subfields

• AI consists from a number of subareas which, in many ways, are converging by using common building blocks

• ...recently, Machine Learning is generating advances in most of AI subfields

AI, a hot trend in today’s business
In 50 years, this 18-month period we’re in now will be seen as being crucial for the future of the A.I. community.... It’s when the A.I. community finally woke up and took itself seriously and thought about what to do to make the future better.”

Stuart Russell
Computer science prof. at UC Berkeley

Q1’17 MOST ACTIVE QUARTER FOR AI STARTUPS

Before the close of Q1’17 (as of 3/23/17) AI startups received 245 deals and $1.7B in funding. Nearly 48% of the deals in Q1’17 were in the seed/angel stage, indicating newer companies are continuing to enter the space.

### AI HEATMAP: DEALS DISTRIBUTION BY CATEGORY

**Q1'12-Q1'17 (as of 3/23/17)**

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*Low deal saturation* | *Mid deal saturation* | *High deal saturation*

Why AI now? What made the difference?

• The key difference is availability of resources
  • ...computing power, storage, open source software
  • ...developments in AI algorithms in after 2010 (especially deep learning)
  • Data availability is the key – data fuels modern AI

• ...and, the technology is available to everyone for a reasonable price
  • An undergrad Computer Science student can today produce results, which 10 years ago whole scientific community couldn’t do
Demonstration of some of the AI building blocks
Demo: Support Vector Machine

• A method which revolutionized Machine learning in late 90ties
  • Used in many AI solutions as an atomic building block

• Basic principle:
  • constructing a model (analytical function) separating red from blue points
Demo: Neural Networks

- Neural Networks appeared first in early 90ties, but really revolutionized AI after 2010
  - Today Neural networks are a synonym for “Deep Learning” solving several previously unsolved problems

- Neural networks are a composition of many very simple building blocks (analytical functions)
  - Once we connect them in a large connected network, they can jointly solve state-of-the-art AI problems
  - Consisting from neurons, connected with synapses to simulate architecture of the brain

- Demonstration of Google’s TensorFlow package:
  - [http://playground.tensorflow.org](http://playground.tensorflow.org)
Demo: Semantic Annotation

- Extracting semantics from text is still largely an unsolved problem
  - ...today we can extract shallow semantics for the purpose of better search
- The system Wikifier (http://wikifier.org/) annotates and disambiguates text fragments in 100 languages
Demo: Understanding Global Social Dynamics

• Understanding whole world is sometimes easier than one document

• The system “Event Registry” ([http://eventregistry.org/](http://eventregistry.org/)) monitors 150k sources in real time and organizes information in events and storylines
Demonstrating Reasoning with Knowledge

- It is “easier” to understand millions of documents than a single document.
  - ...reading and understanding a single document is micro-reading.
- The following experiment is on how much knowledge we can extract from individual documents.
  - ...extraction is in a form of first order inferentially productive logic.
  - ...allowing us full reasoning to identify new facts.
  - ...minimizing human involvement, optimizing precision and recall.

Diagram:
- Document → Assertions → Reasoning → Dialogue
Who has a motive for the assassination of Rafik Hariri?
Query & Answer

Query: Who or what had a motive for the assassination of Hariri?
Answer: al-Qaeda

Because:

Since 2000, Lebanon has been responsible for according with Lebanese economic reform.
February 14, 2005 was the date of the assassination of Hariri.
Rafik Hariri was killed during the assassination of Hariri.
Rafik Hariri is an advocate of Lebanese economic reform.
A1 Quada opposes Lebanese economic reform.

Detailed Justification:
A1 Quada had a motive for the assassination of Hariri.

External Sources:


If

* some intelligent agent opposes some policy,
* and some other intelligent agent VICTIM is an advocate of that policy,
* and some other intelligent agent ADOPTER is responsible for according with the policy,
* and it is adopted by ADOPTER in any some ADOPT-TYPE,
* and some ACT prevents VICTIM from playing the role "key participant" in any ADOPT-TYPE,

then that intelligent agent had a motive for ACT.
Why AI cannot serve real Law challenges yet?
Al & Law challenges

• AI, despite its successes, is still rather shallow in what it is solving
  • ...when people in AI say “deep”, they really mean “deeper than before”
  • The challenge of the “real depth” is still ahead

• Law, on the contrary, requires “real depth” from the start
  • The domain of Law addresses all aspects of life, from emotional to material, and altogether is still far too complex for AI to approach holistically
  • ...and, Law operates predominately with “natural language”
Language vs. World

The limits of my language means the limits of my world.

Ludwig Wittgenstein

• ...at this point in time, we have ‘language’, but the ‘world’ is in AI more or less missing

• So – so what a ‘world’ or ‘world model’ could be?
Language is really a social sensor...

• Nature’s (society’s) physical reality is very complex...
  • ...but manifests itself in a simple and structured way

• Humans need a mechanism to capture the complexity they need to survive, evolve and communicate
  • ...that’s why the language appeared as a necessity

• Consequently, human language is a reflection of the world in which we live and our perception of it:
  • Some of the key properties: Uncertainty, context, dynamics, compressed information
Nature is complex – but whenever Nature gets optimized it gets towards a simple and clear structure.

Human perception is just a simplified reflection of how Nature shows itself.

Language is a means how to communicate the perception – kind of a sensor for the structures beneath.

Common understanding of the Nature we call Knowledge

The bottleneck between AI and Law
Why we need a World Model?

Model of the world...
• ...beyond surface knowledge
• ...to interconnect contextualized fragments

Why?
• To make reasoning capable of connecting isolated fragments of knowledge
• **To derive new knowledge** beyond materialized factual knowledge
When AI and Law can really meet?

• The key element is “representation of the world” in which Law operates

• When AI will be able to represent more complex world models...
• ...and, when Law will formalize (technically) its domain accurately,
• ...then AI will be able to reason about legal issues.

• Until this happens, AI can only be useful in scenarios/applications where shallow solutions are enough
  • ...this includes smart search, classification, anonymization, ...
Further reading
Relevant further references

• How will artificial intelligence affect the legal profession in the next decade?
  • http://law.queensu.ca/how-will-artificial-intelligence-affect-legal-profession-next-decade

• Artificial Intelligence in Law: The state of play 2016

• Artificial Intelligence and Law (Springer Journal)
  • http://link.springer.com/journal/10506

• Artificial intelligence and the law

• 2016 Legal Tech/Legal Industry Predictions: What Do the Prognosticators See?
Conclusions
Summary

• AI made huge relative progress recently, but in absolute terms it is still far from humans when it comes to reasoning with complexity.

• Law tries to be conservative and relies on human judgement (although imperfect) to manage the complexity of the real world.

• AI is moving forward, but slower as it seems
  • Recent successes and marketing raise expectations too much.