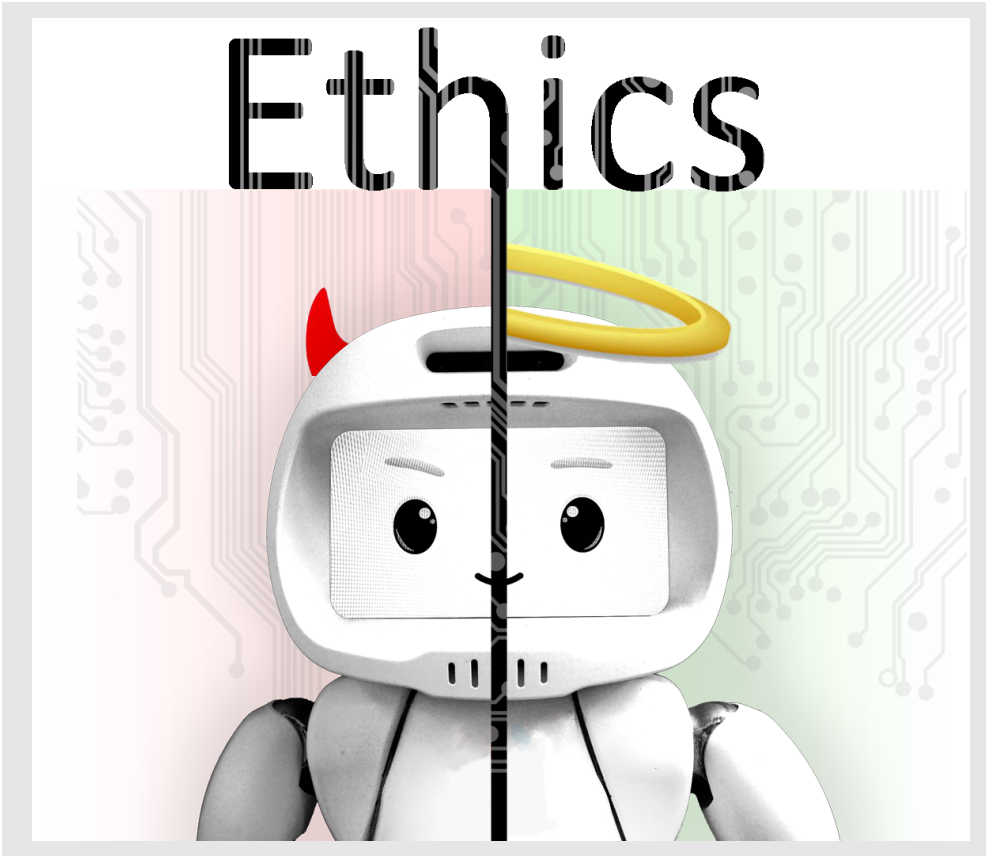
Ethico-legal Governance of Intelligent Artificial Agents

Can post-hoc normative reasoning competencies prevent AI systems from going rogue?

Christoph Benzmüller

Freie Universität Berlin & Latentine GmbH

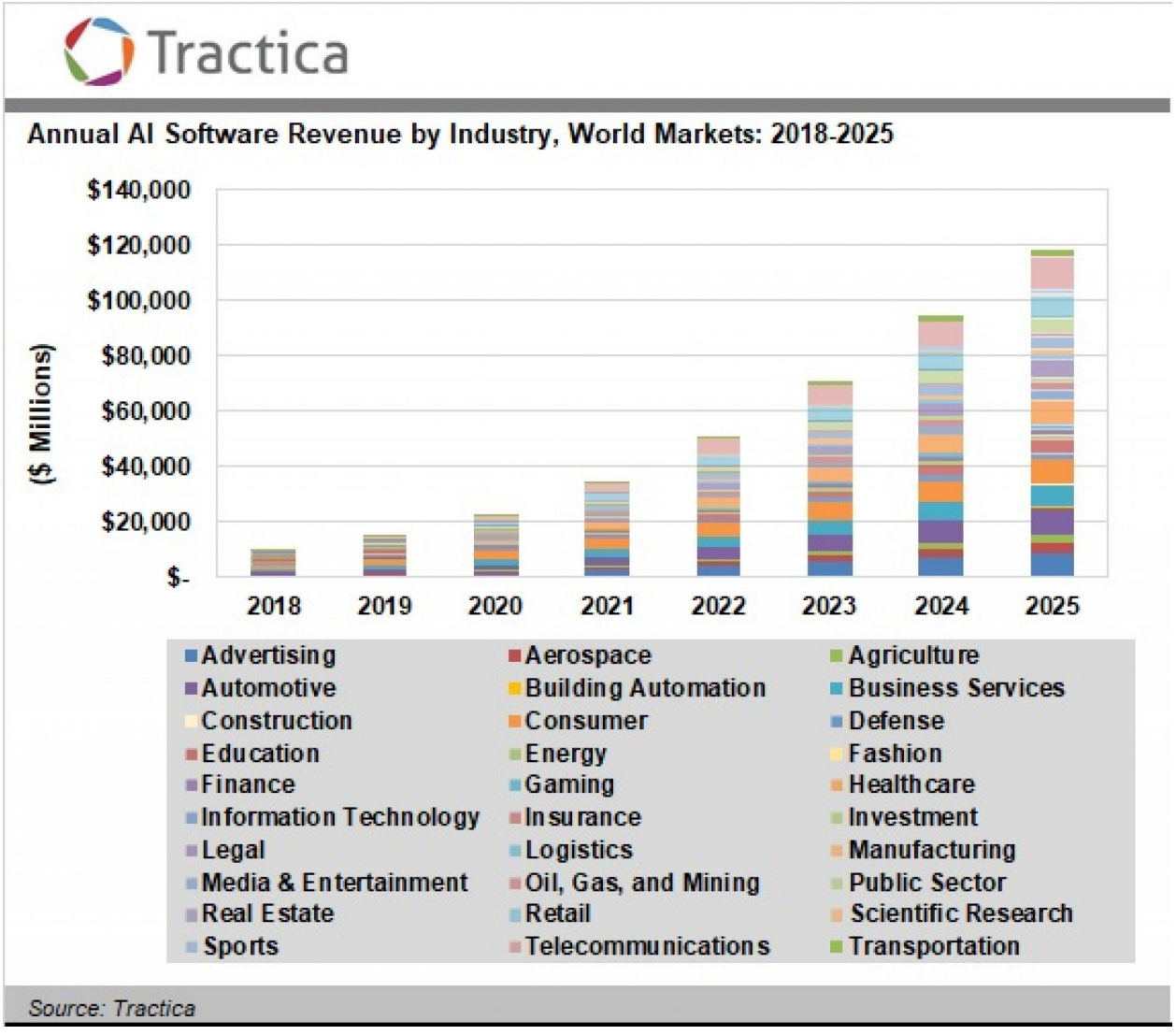


ZJULogAI, 26. Oktober, 2020

Talk Structure

1. What is AI?
2. Own position
3. How to create trust & how to control?

What is AI?



Steam engine of the 21st century?

What is AI?

NEWS

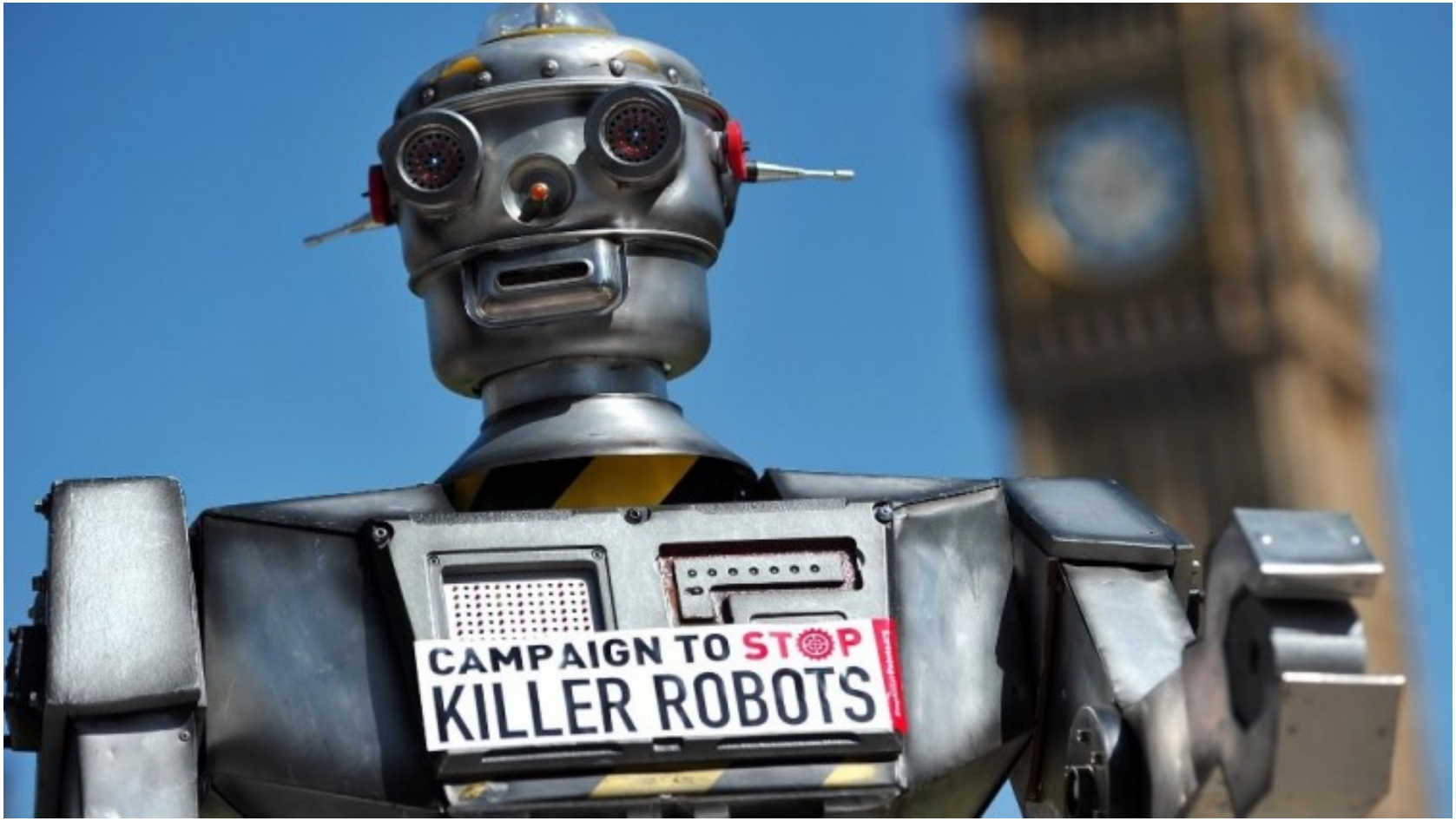
Bitkom: Digitalization to wipe out millions of jobs in Germany

Millions of workers in Germany will likely lose their jobs and be replaced by robots and AI algorithms by 2023, German IT association Bitkom said in a study. The group urged politicians to take the issue more seriously.

Source: Deutsche Welle, Feb, 2018

A source for social tensions
and diverging wealth distribution?

What is AI?



Source: Deutschlandfunk/AFP, Carl Court, 2019

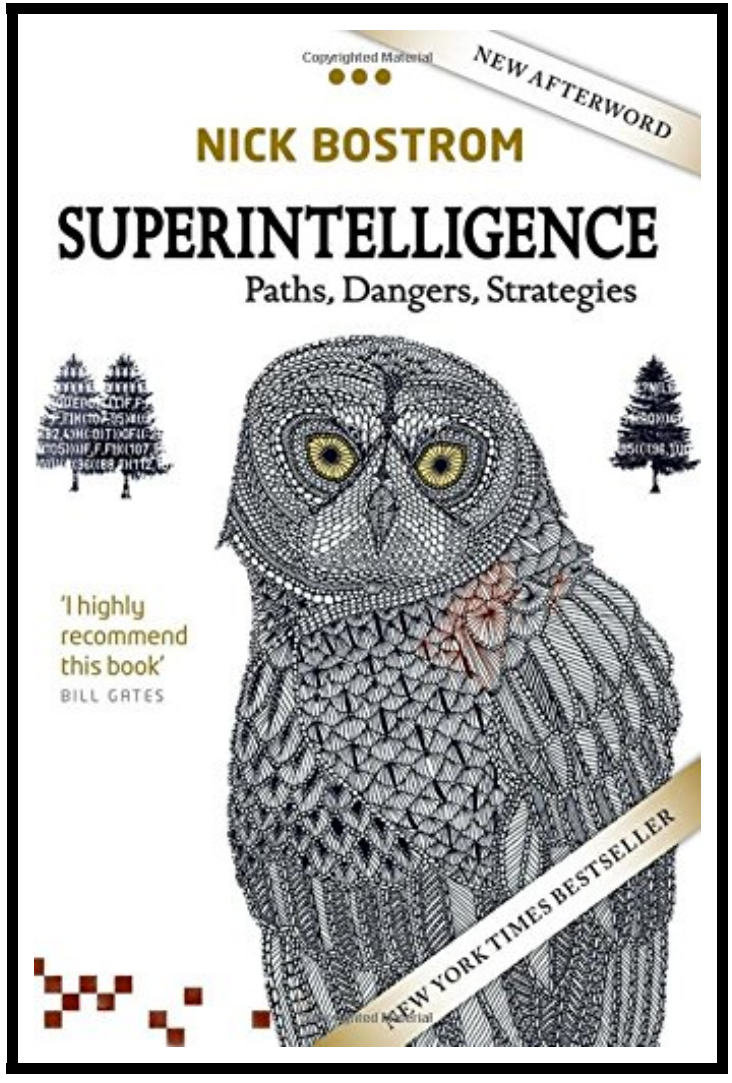
A danger regarding military escalation?

What is AI?

Source/Photograph: Qiangjing Evening News

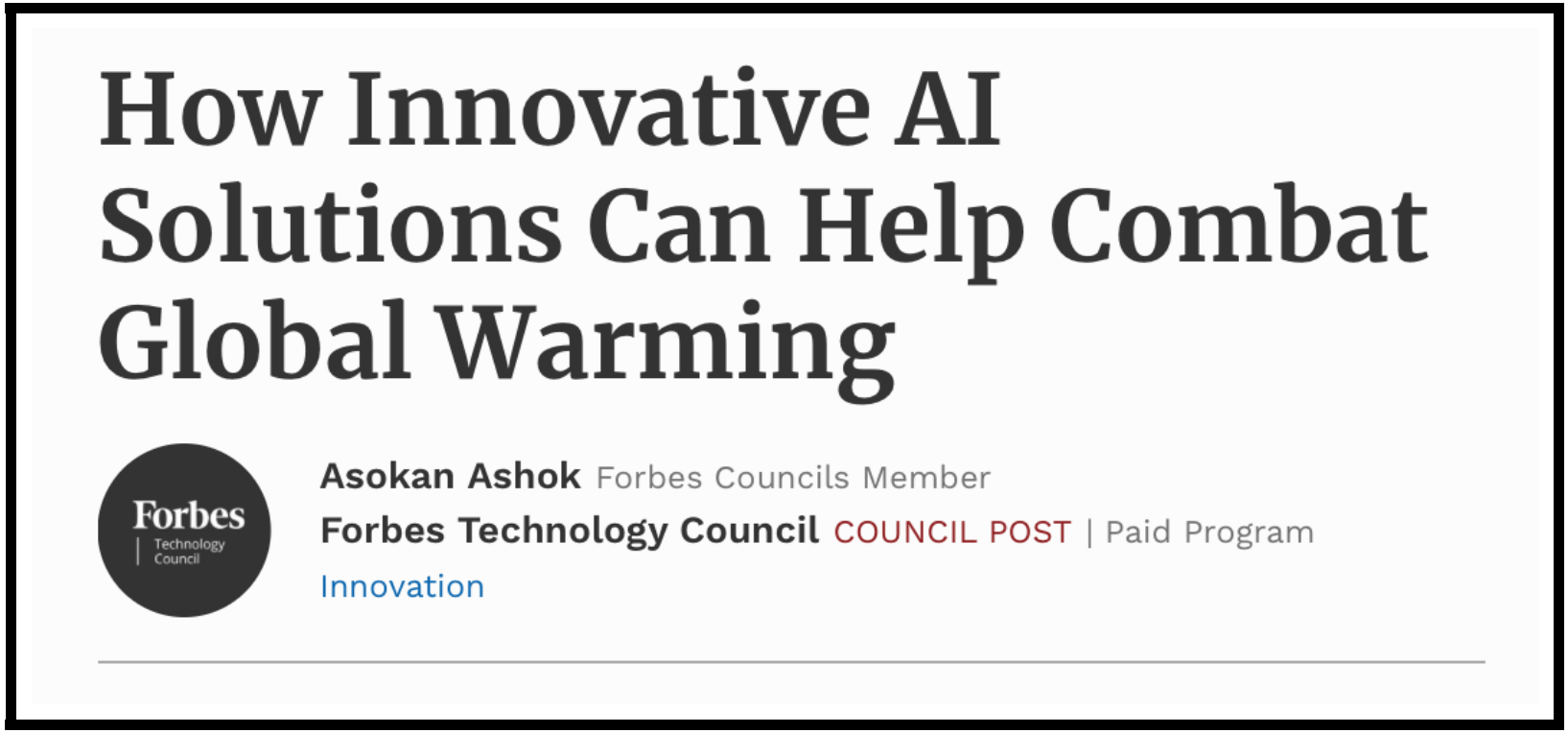
An interesting option for future partnerships?

What is AI?



A new evolutionary step that leaves people behind?

What is AI?



How Innovative AI Solutions Can Help Combat Global Warming

Forbes Technology Council

Asokan Ashok Forbes Councils Member

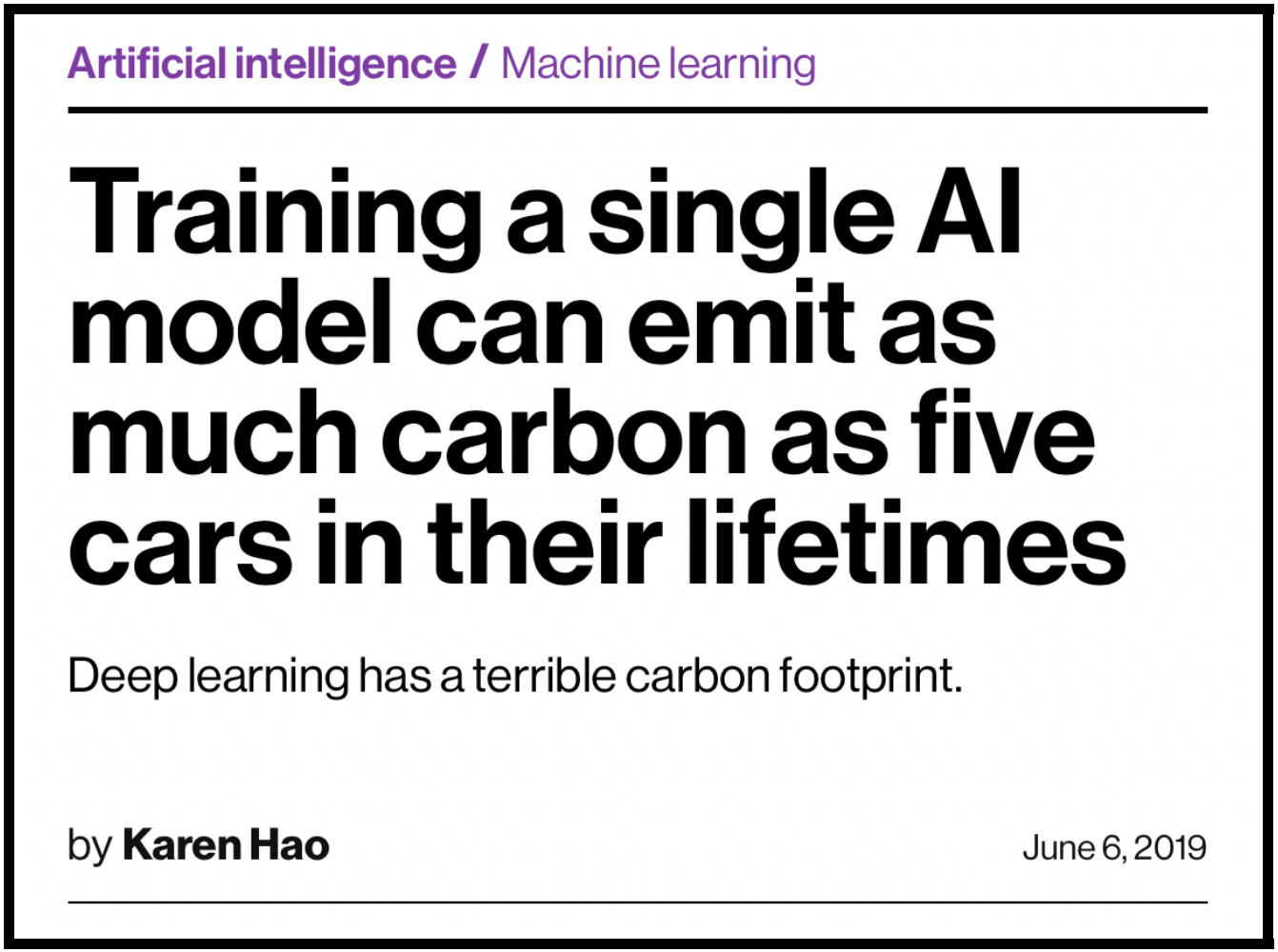
Forbes Technology Council COUNCIL POST | Paid Program

Innovation

Source: Forbes, 2020

A tool for combatting our environmental sins?

What is AI?



Artificial intelligence / Machine learning

Training a single AI model can emit as much carbon as five cars in their lifetimes

Deep learning has a terrible carbon footprint.

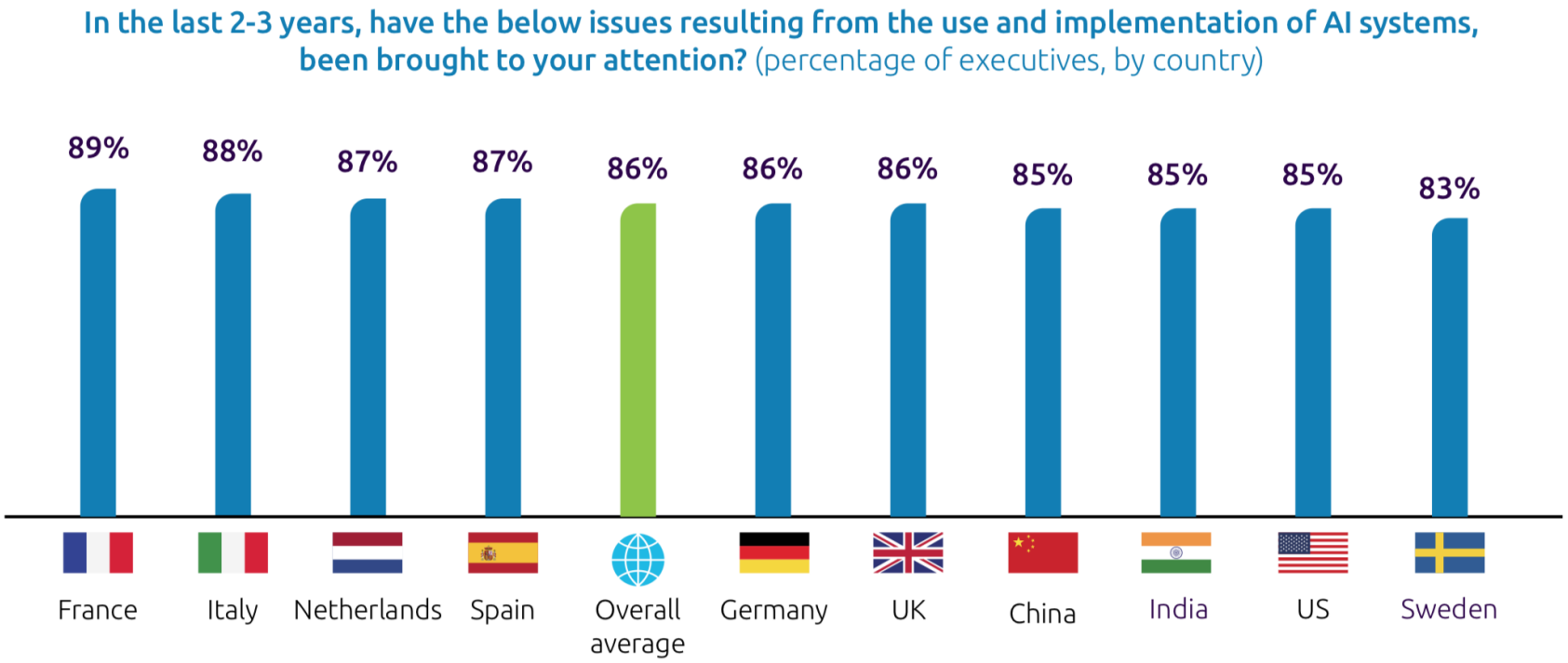
by **Karen Hao** June 6, 2019

Source: MIT Technology Review, 2019

Itself the next big environmental sin?

What is AI?

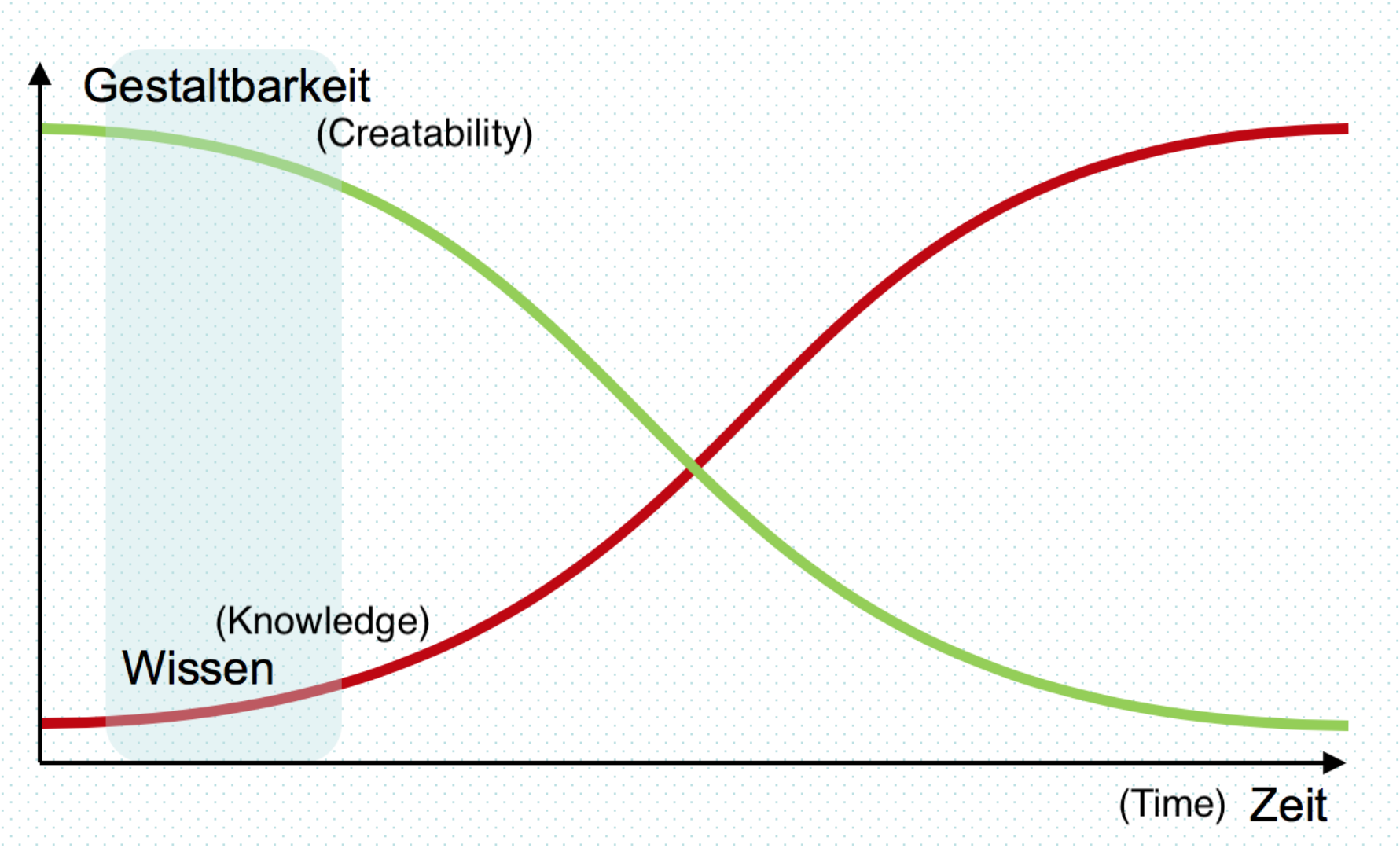
Figure 4. Nearly nine in ten organizations across countries have encountered ethical issues resulting from the use of AI



We presented over 40 cases where ethical issues could arise from the use of AI, to executives across sectors. We asked them whether they encountered these issues in the last 2-3 years.
Source: Capgemini Research Institute, Ethics in AI executive survey, N = 1,580 executives, 510 organizations.

Source of ethical and legal conflicts?

What is AI?



Challenge for active participation!

What is AI? – Many definitions, no consensus

Weak/Applied AI
Limited, 'smart' systems that simulate intelligence

vs.

Strong AI
Machines with (at least) general human intelligence

Cognitive Simulation
Exploring and testing theories of human cognition with computers

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- *AI is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.* **(McCarthy)**
- *The study of how to make computers do things at which, at the moment, people are better.* **(Rich and Knight)**
- . . .
- *Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather it reflects a broader and deeper capability for comprehending our surroundings – 'catching on', 'making sense' of things, or 'figuring out' what to do.* **(Gottfredson, 1997)**

What is AI? – Many definitions, no consensus

Weak/Appl … **rong AI**
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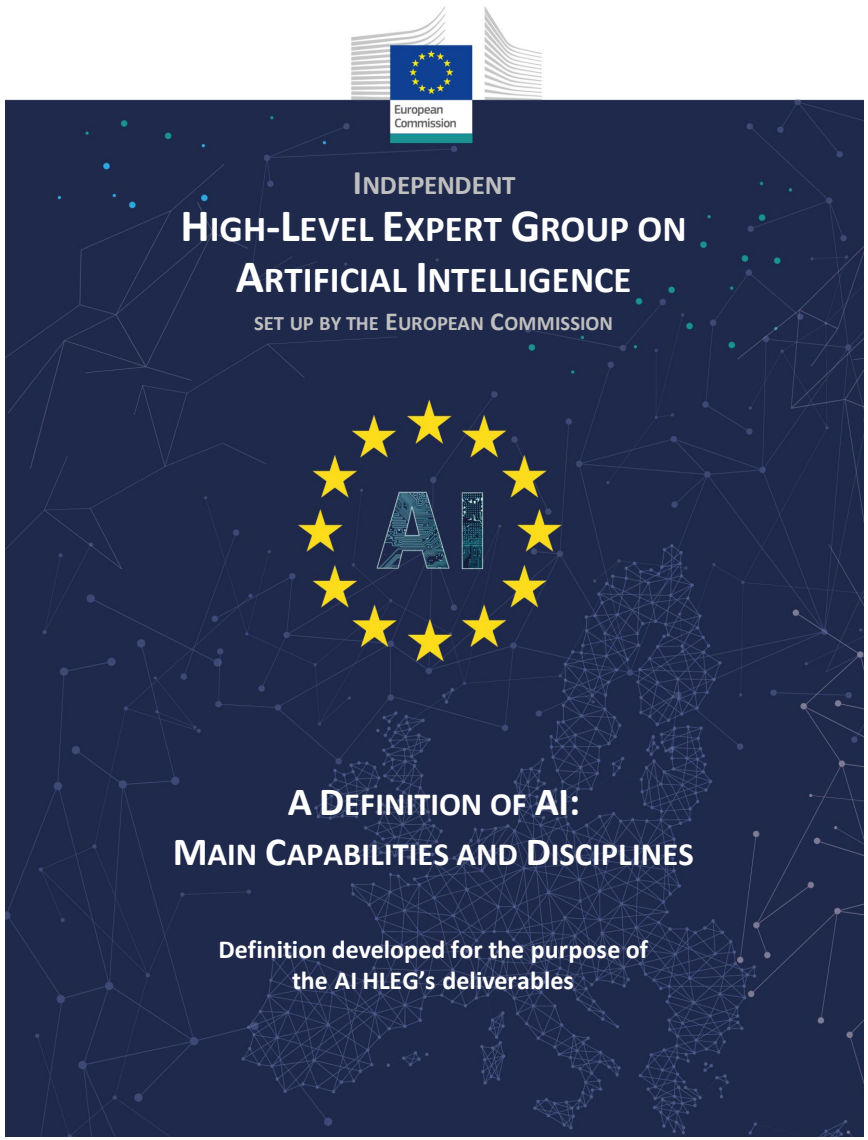
simulate inte… …intelligence



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AI – Own working definition

Def.: Artificial Intelligence
A science of computational technologies that are developed to achieve and explain **intelligent** behavior in machines.

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Collection of (mental) capabilities that enable an entity

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5. to interact socially with other entities and to adapt own goals and norms to those of a community (for a greater good). **—be social—**

AI – Own working definition

The problem (in my opinion) is not an emerging superintelligence!

The problem is:

- use of »severely limited« AI technology (lacking competencies 3-5)
  - . . . within increasingly complex system environments
  - . . . to serve most critical applications
  - . . . in (semi-)autonomous mode

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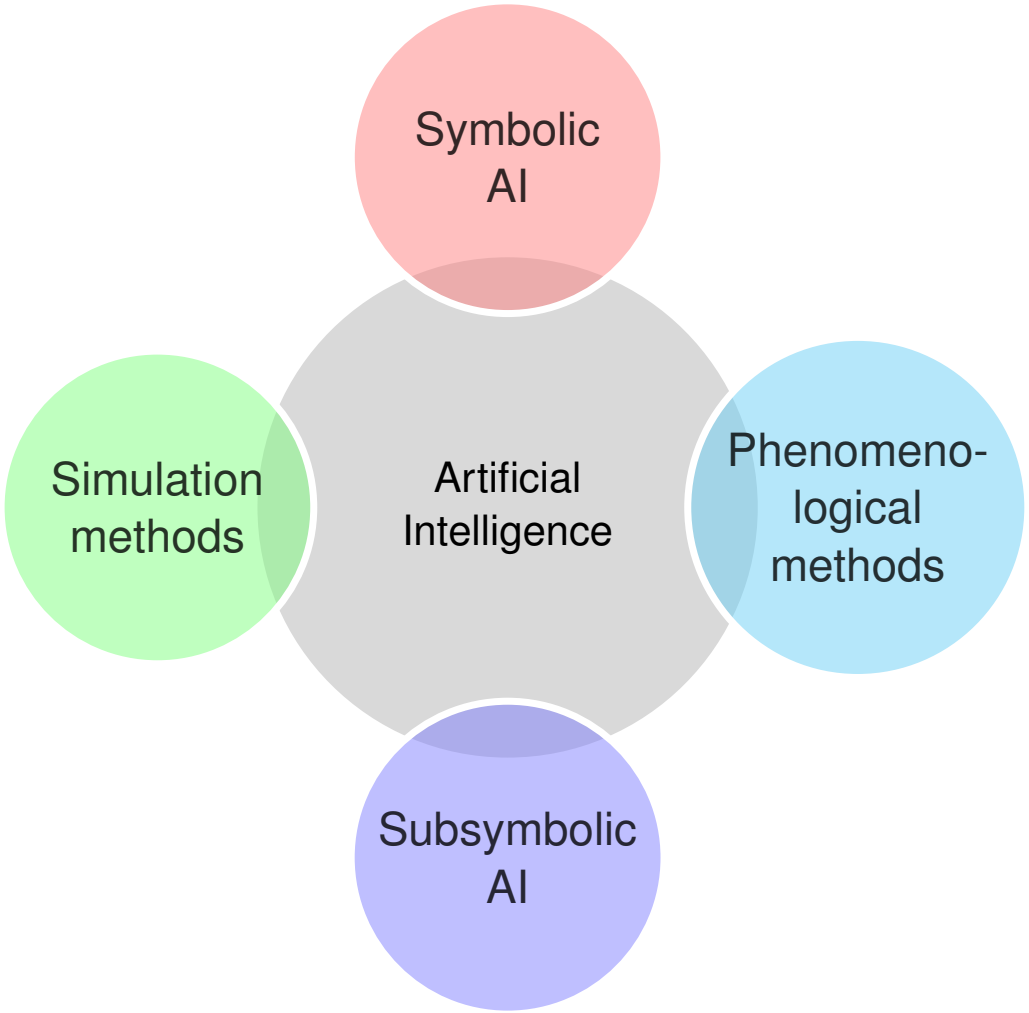
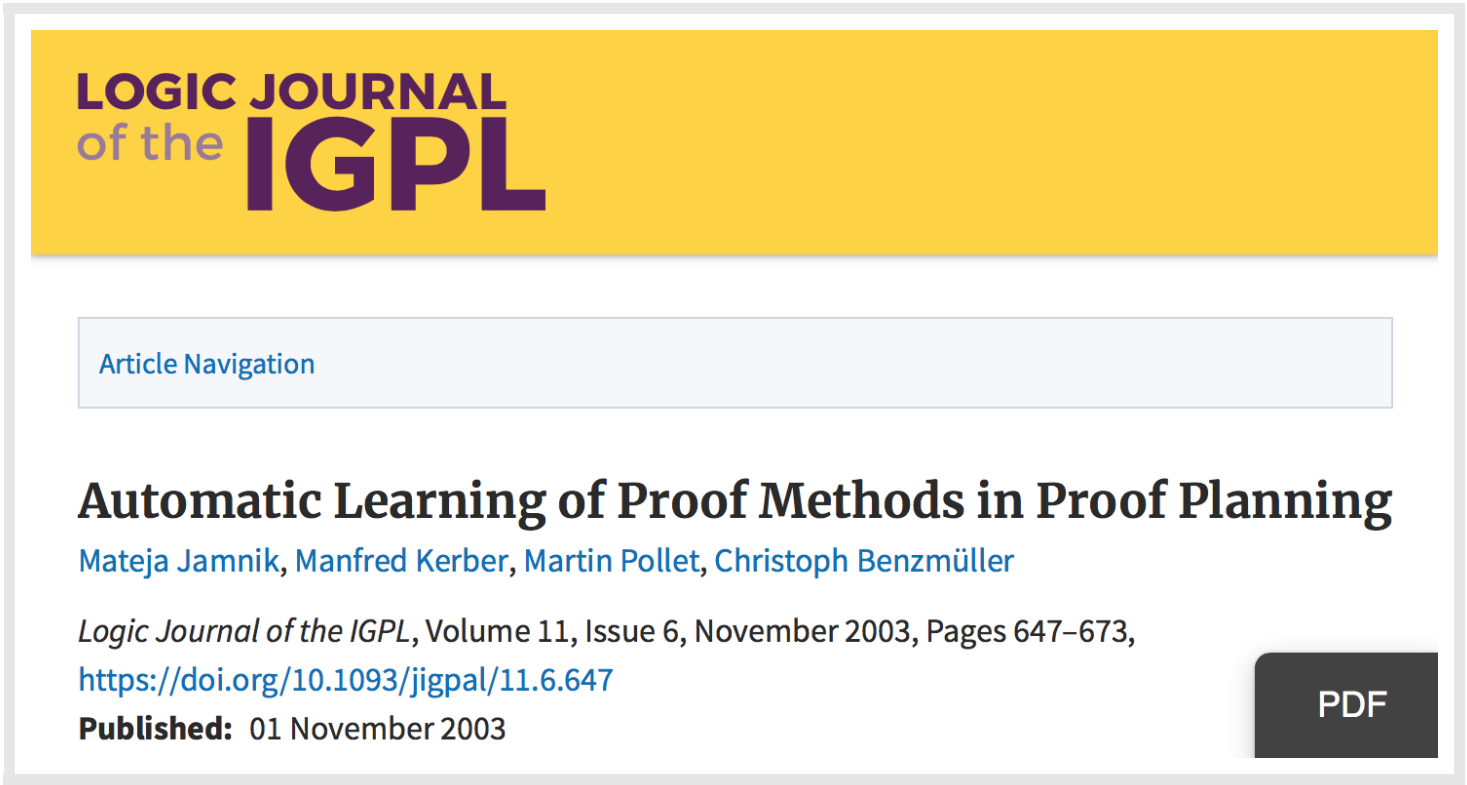
AI – The notion (unfortunately) has changed



- Knowledge Representation
- Logical Reasoning
- Planning
- Multi-Agent Systems
- Search
- ...
- Robotics
- Pattern Recognition & Machine Learning
- Neural Networks

Current (very narrow/limited) notion of AI: Neural Networks & ML

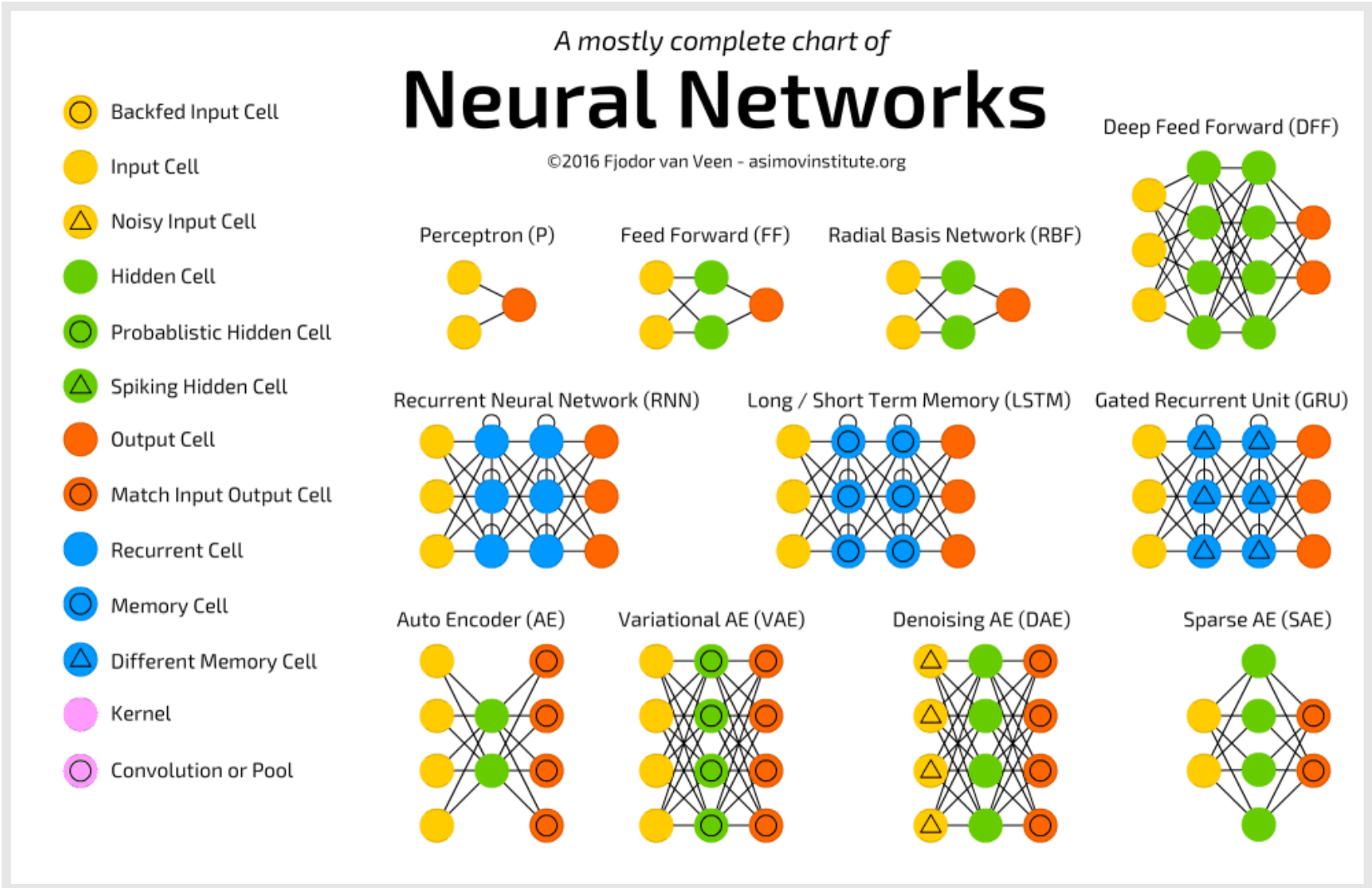
ML not tied to Neural Networks



See e.g. also: Inductive Logic Programming

Neural Networks & Machine Learning

Source: Fjodor van Veen, asimovinstitute.org, 2016



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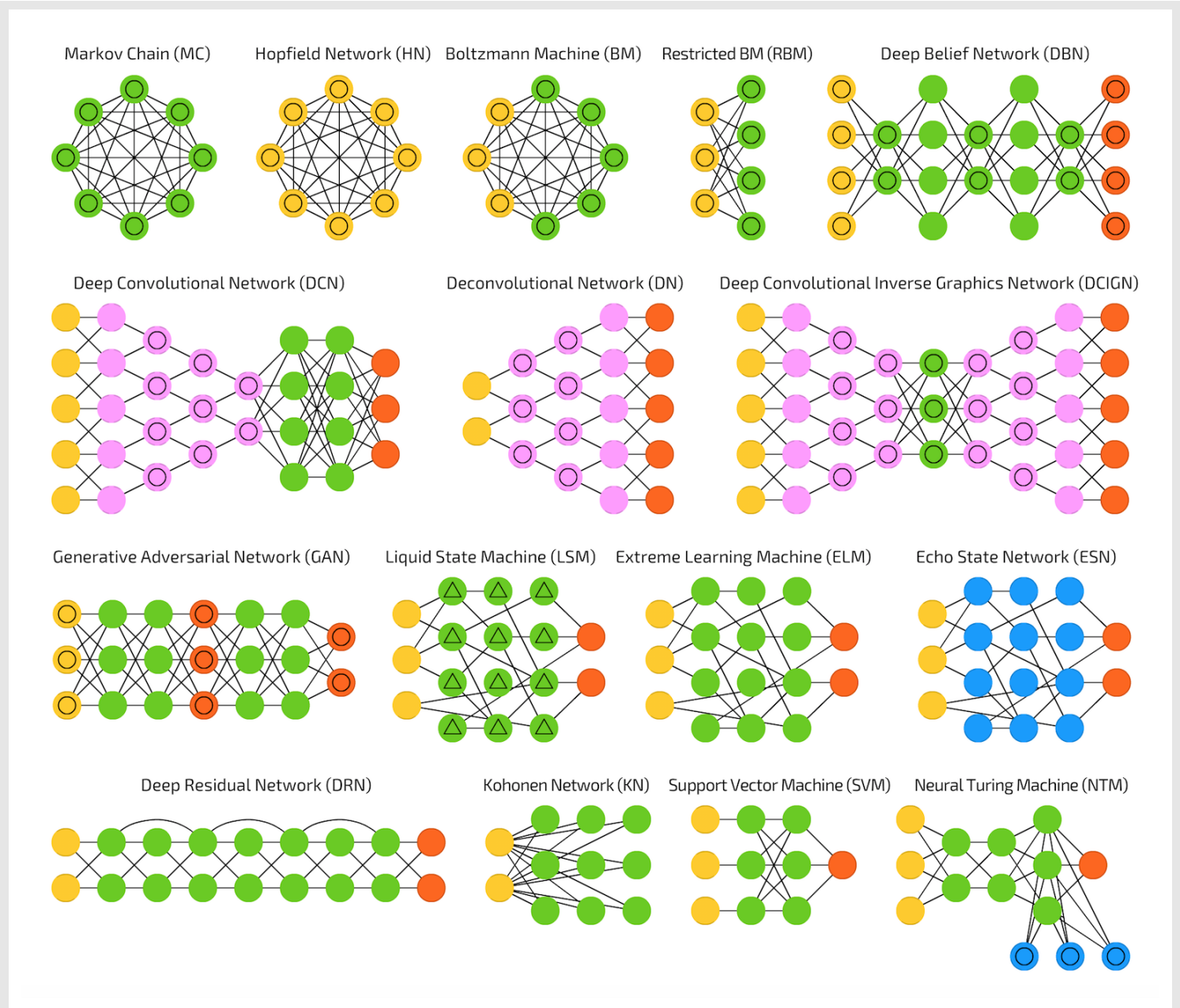

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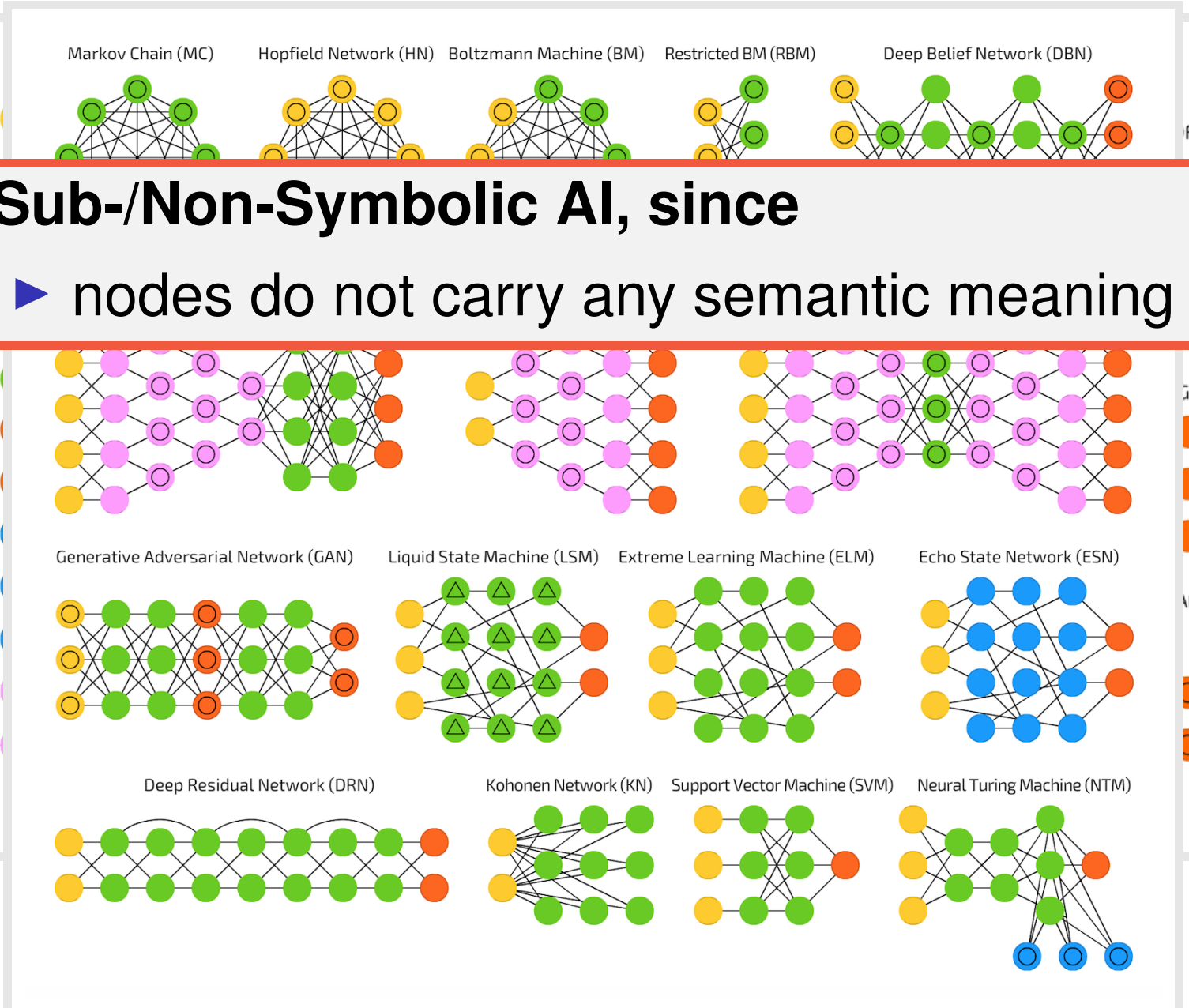

Sub-/Non-Symbolic AI, since

- nodes do not carry any semantic meaning

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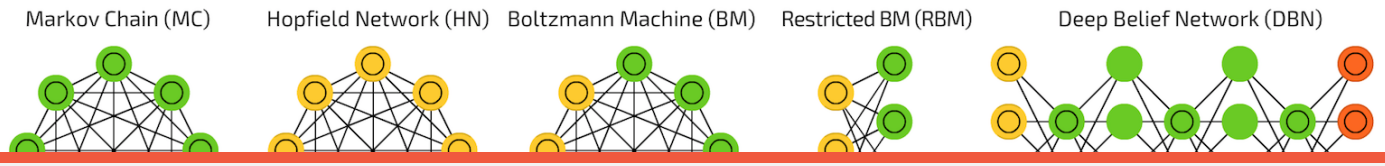

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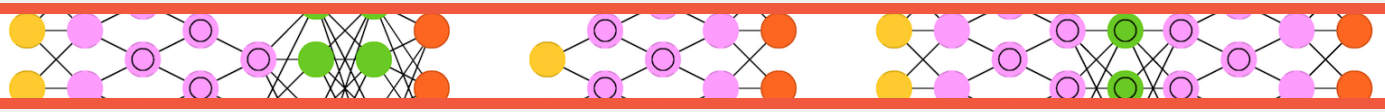
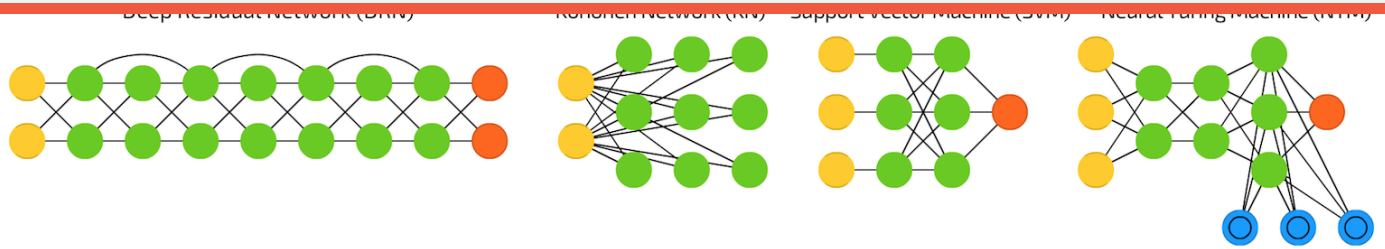


Pros:

- robust & very strong in specific domains

Cons:

- data-intensive training, requires substantial human expertise, intransparent, bias, adversial attacks



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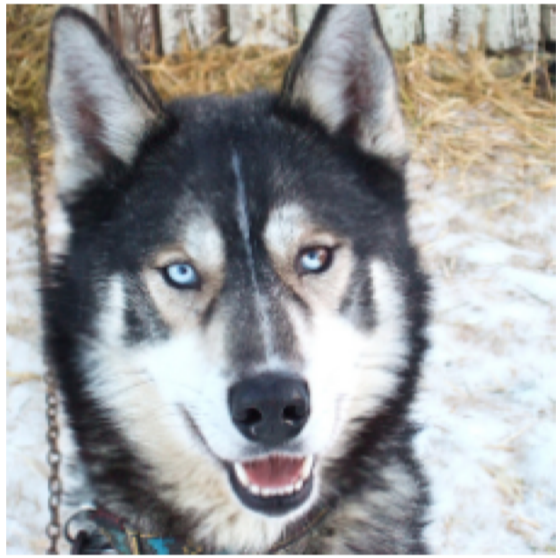


(a) Husky classified as wolf

(b) Explanation

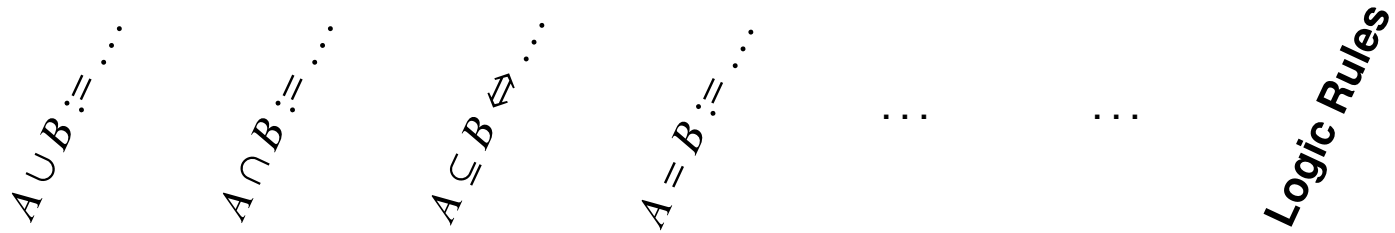
Figure 11: Raw data and explanation of a bad model's prediction in the "Husky vs Wolf" task.

Source: Ribeiro et al., arXiv:1602.04938

Explanation of black box AI systems: often without sense!!
How could »opening this black box« possibly create trust?

(Modified) Cartoon: Nick Newman, Lemmings, The Spectator, 2016

Symbolic AI – Example: Logical Reasoning

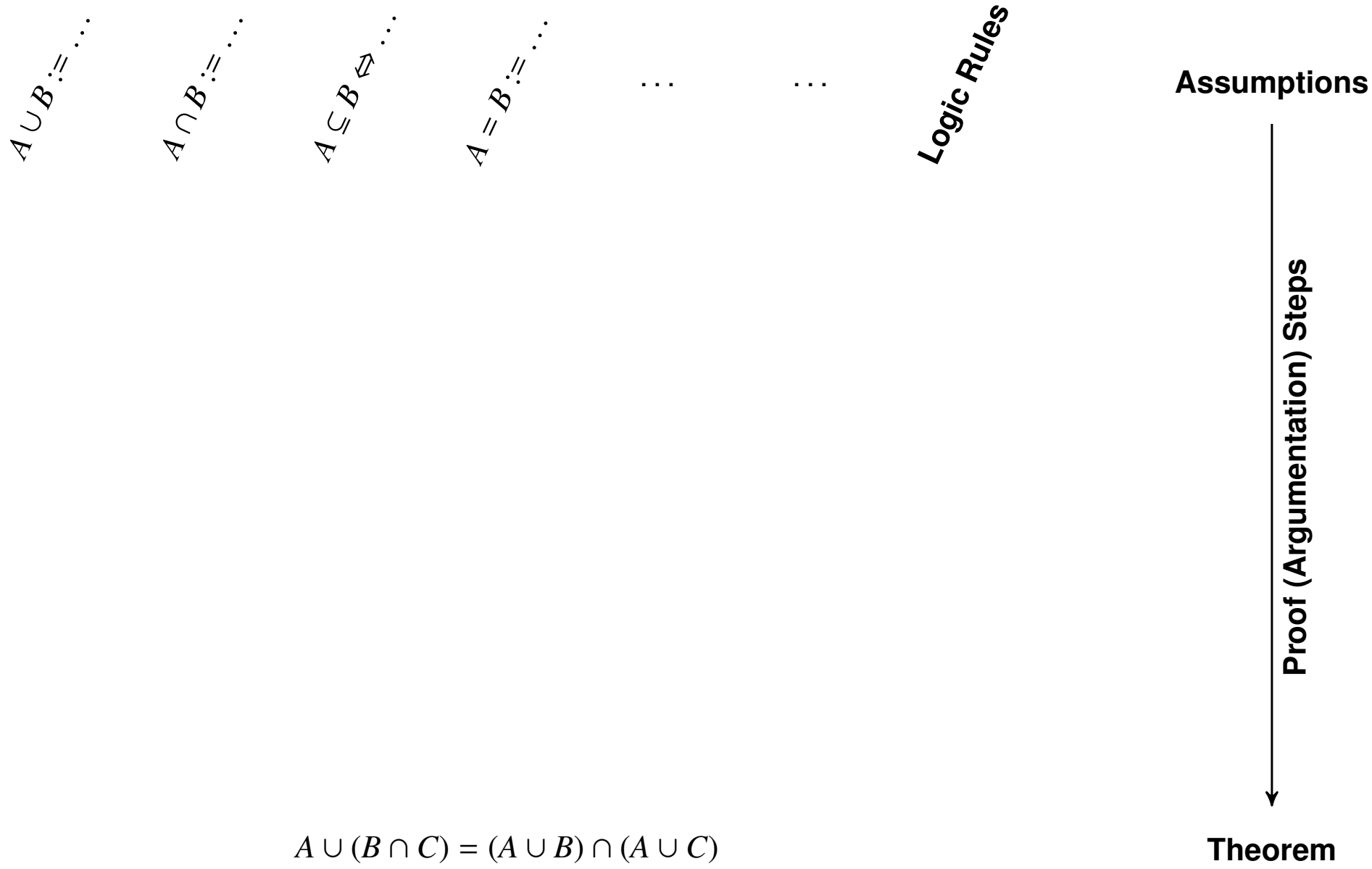


Assumptions

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

Theorem

Symbolic AI – Example: Logical Reasoning



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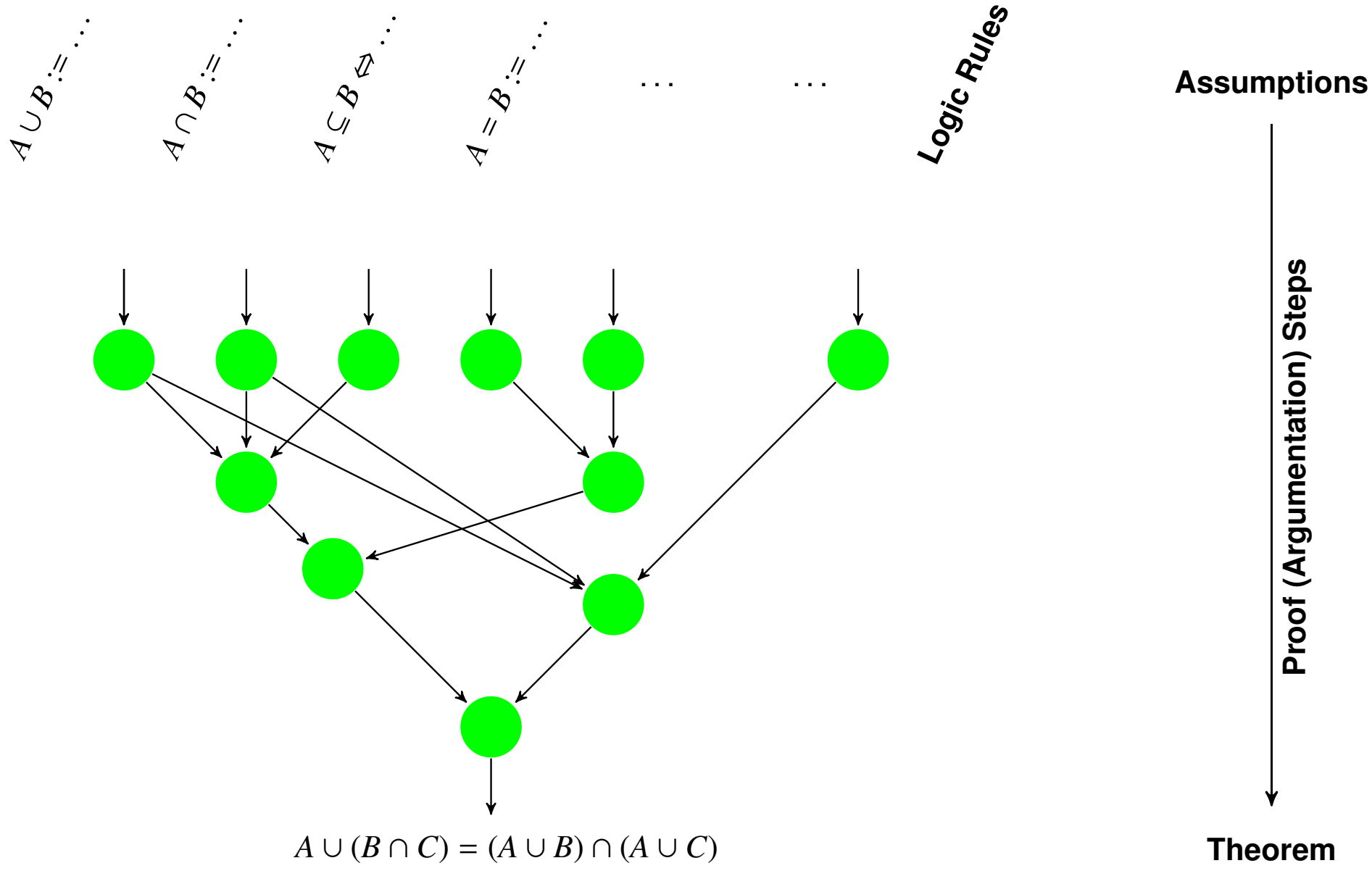

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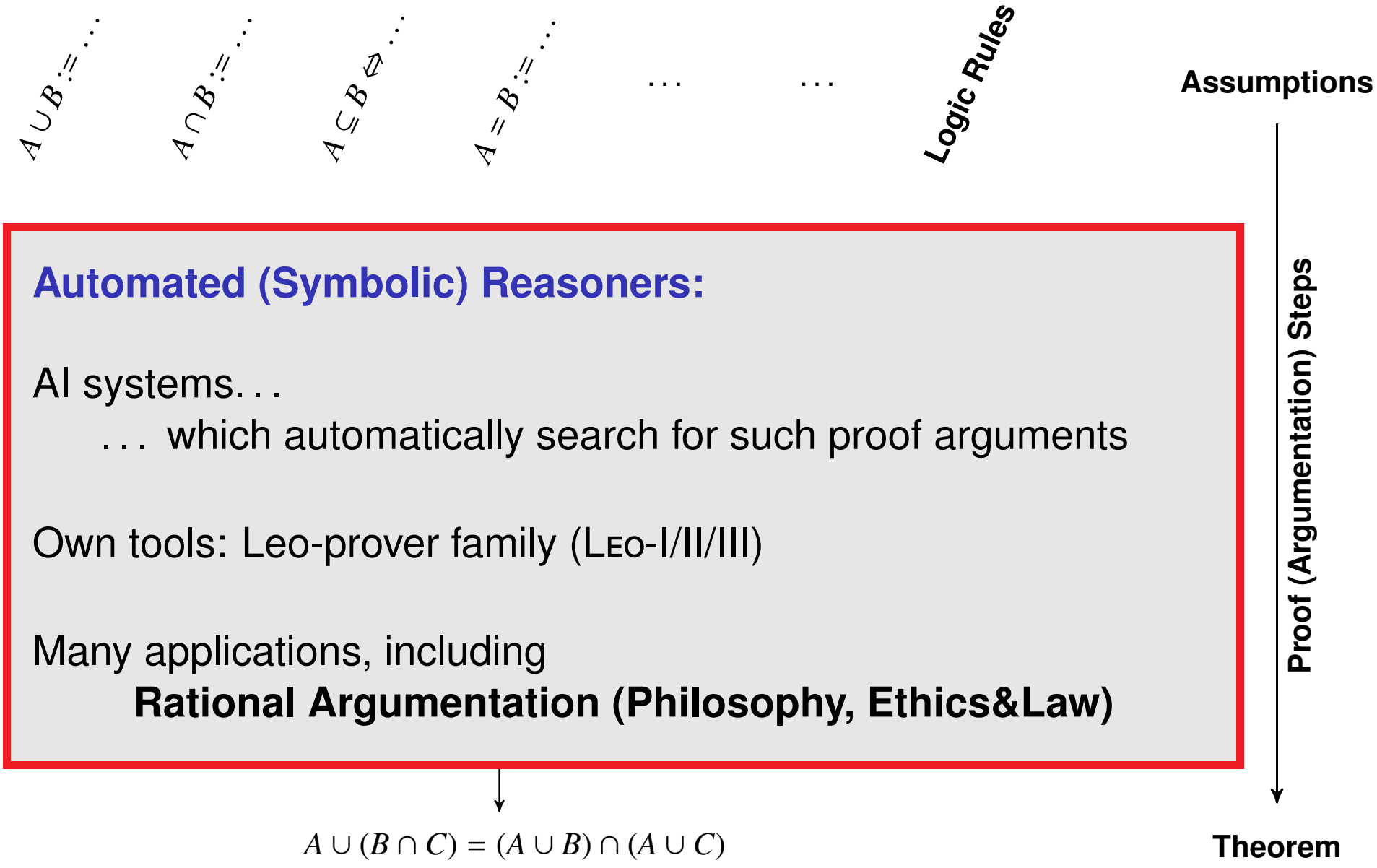


Automated (Symbolic) Reasoners:

AI systems. . .

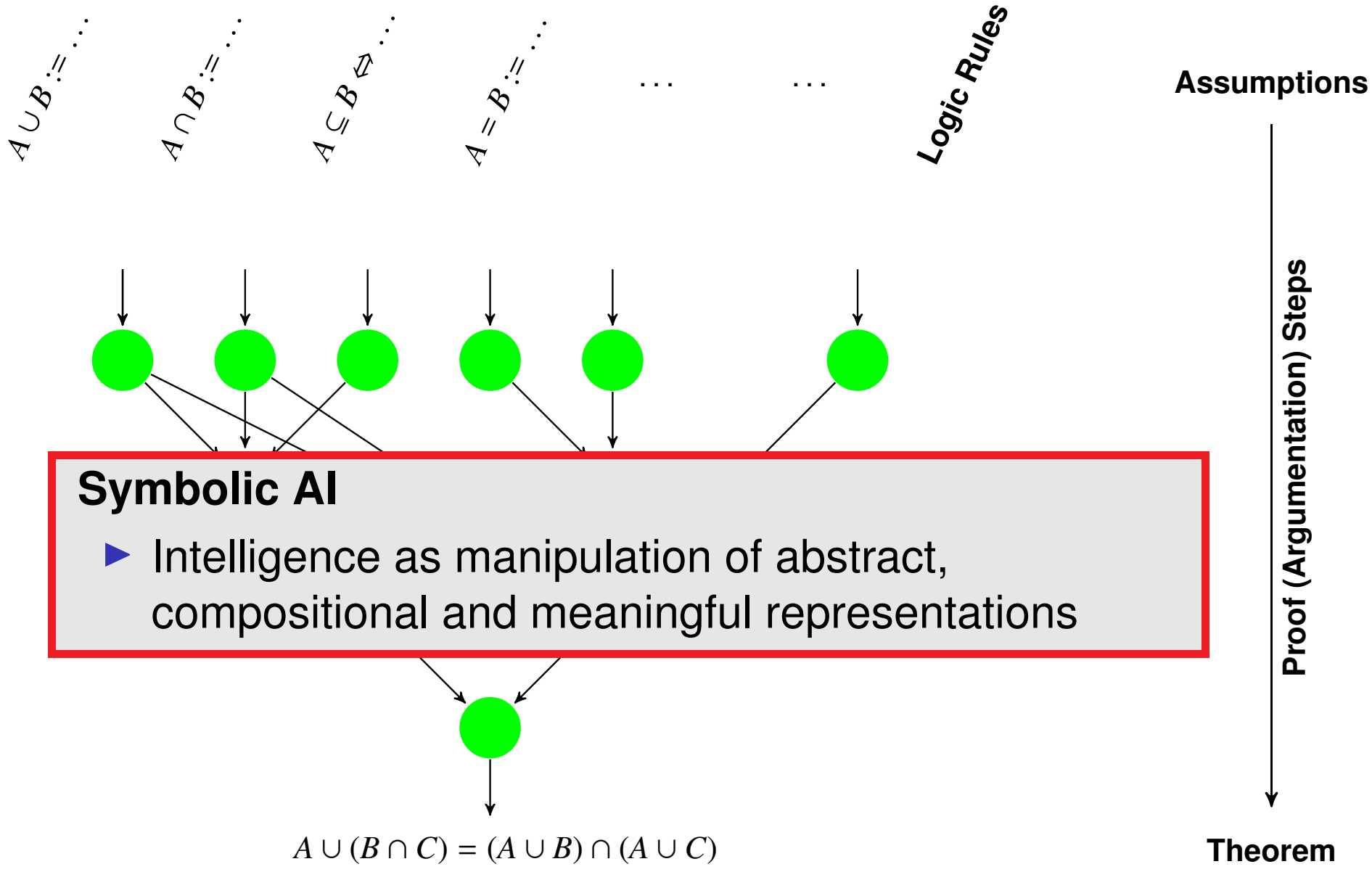
. . . which automatically search for such proof arguments

Own tools: Leo-prover family (Leo-I/II/III)

Many applications, including

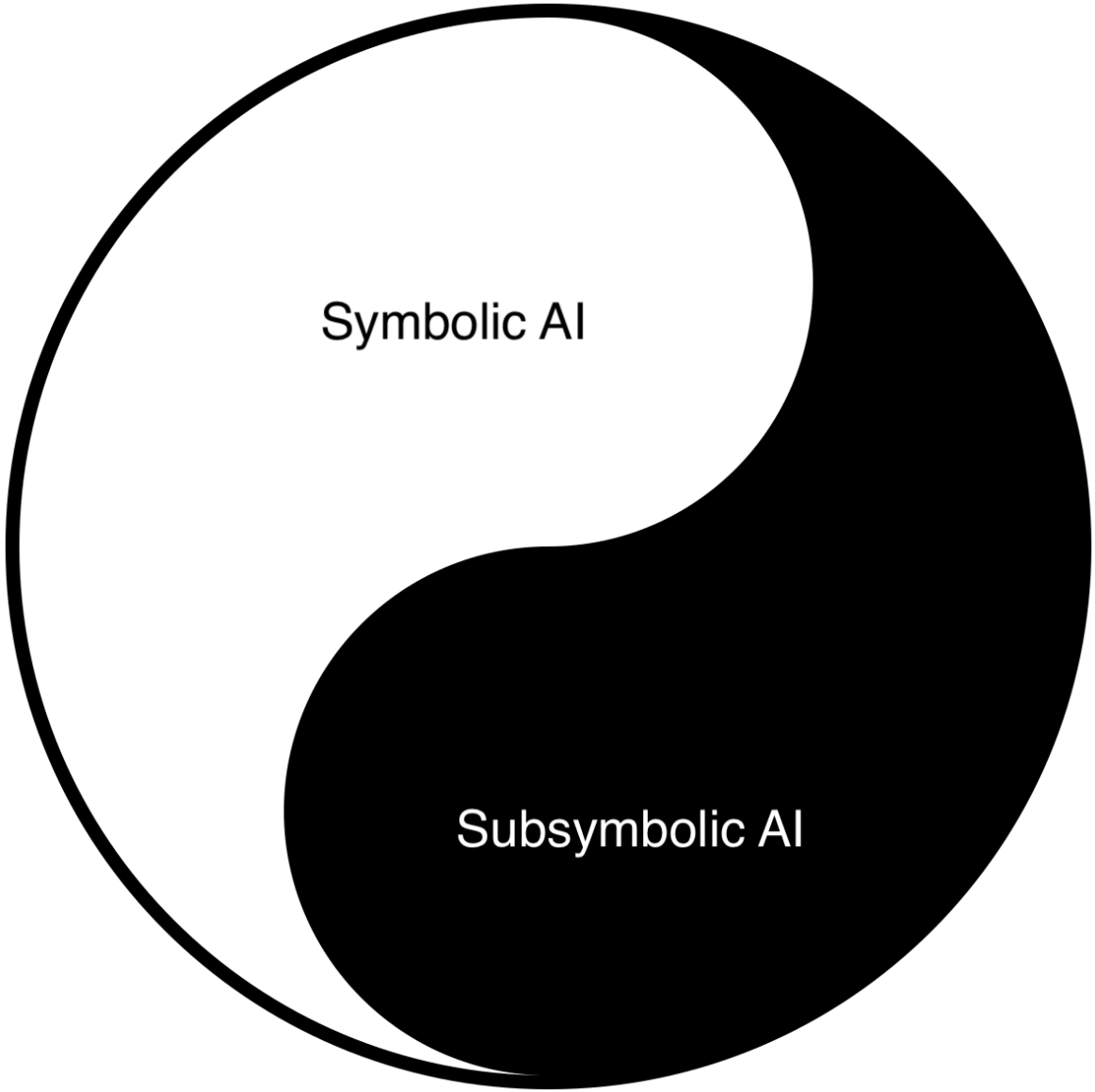
Rational Argumentation (Philosophy, Ethics&Law)

Symbolic AI – Example: Logical Reasoning



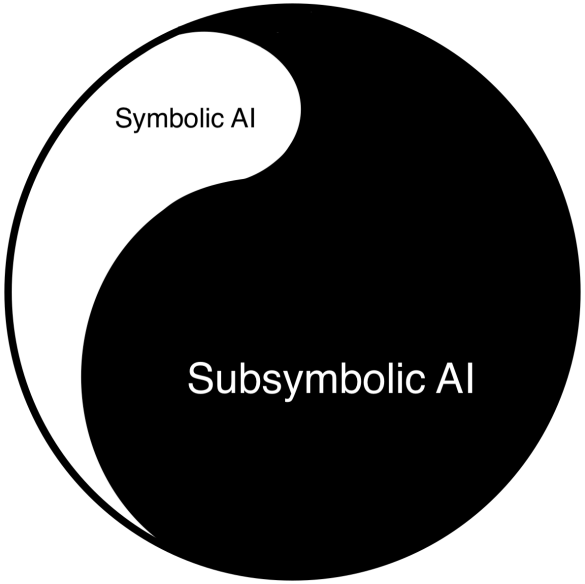
Own Position

Yin and Yang of AI — Own Position



There are many recent calls for a **"Neuro-Symbolic AI"**
(but actually this is an "old hat", isn't it?)

Yin and Yang of AI — Unhealthy Hype!



Examples

- ...
- AlphaGo und AlphaZero: world champion in Chess and Go

(subsymbolic KI)

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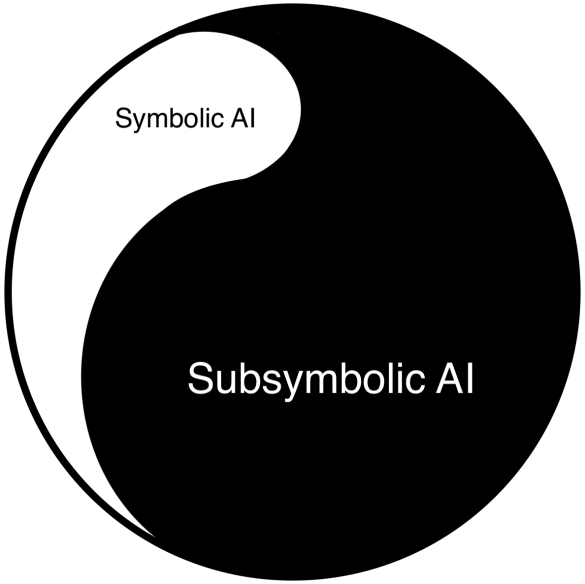

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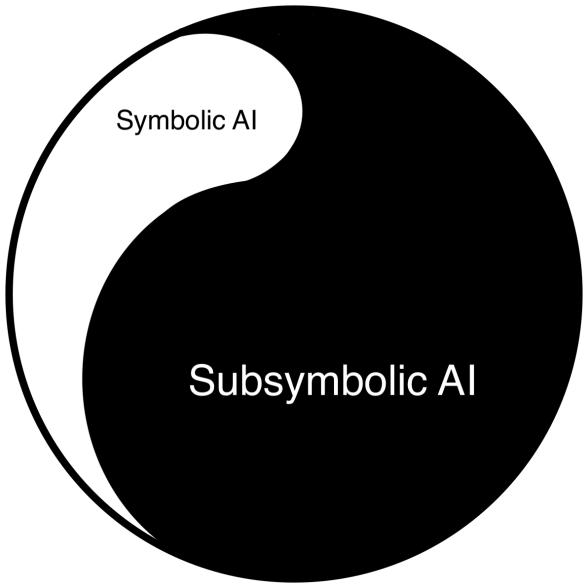

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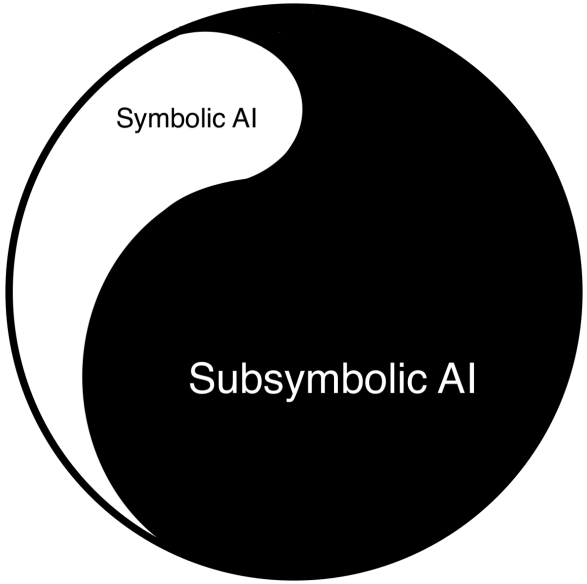

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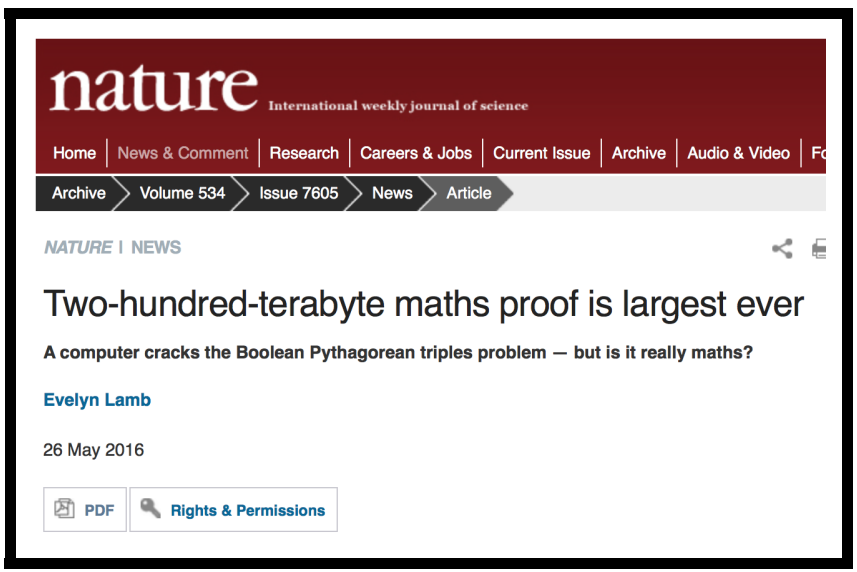

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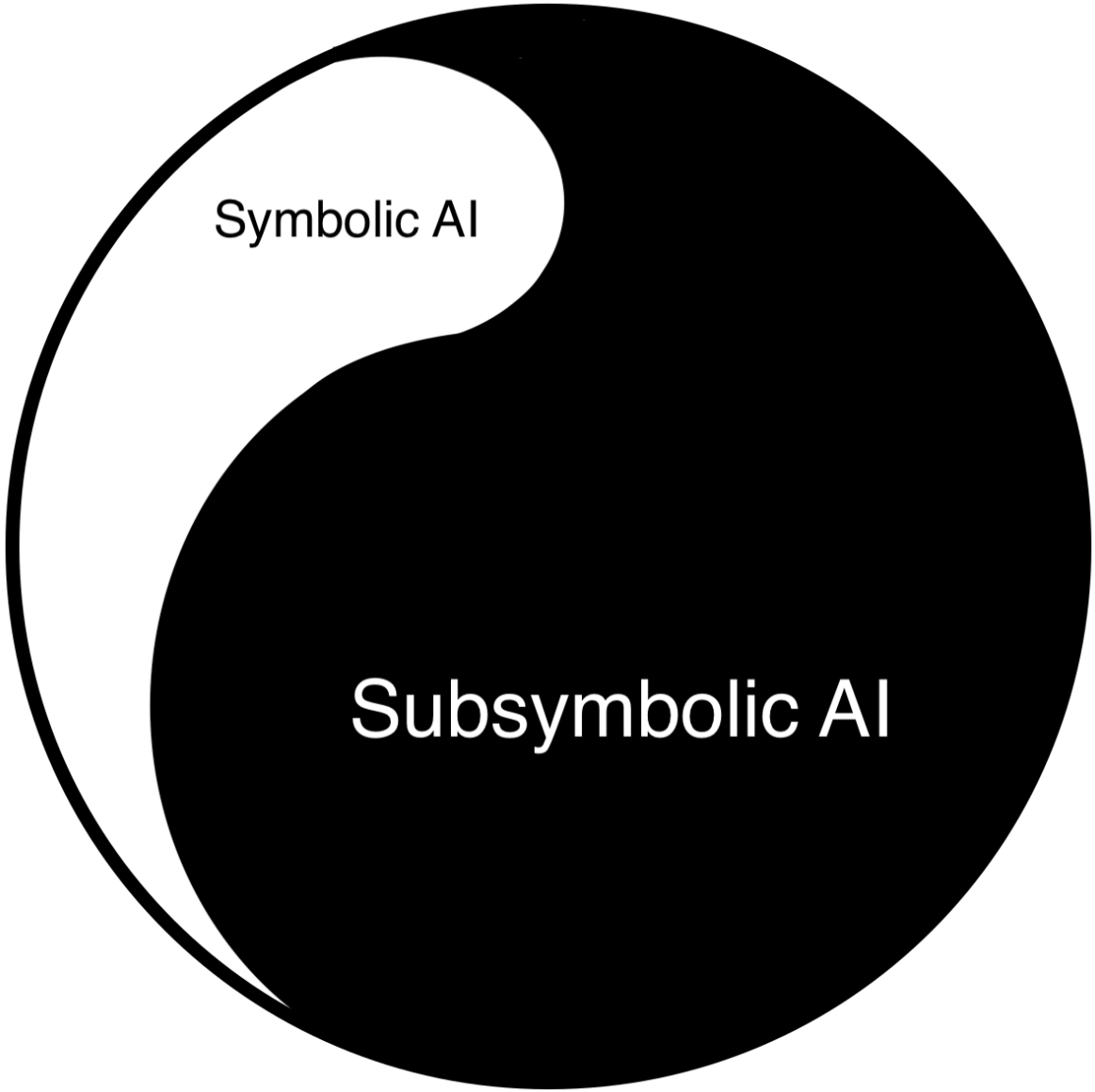
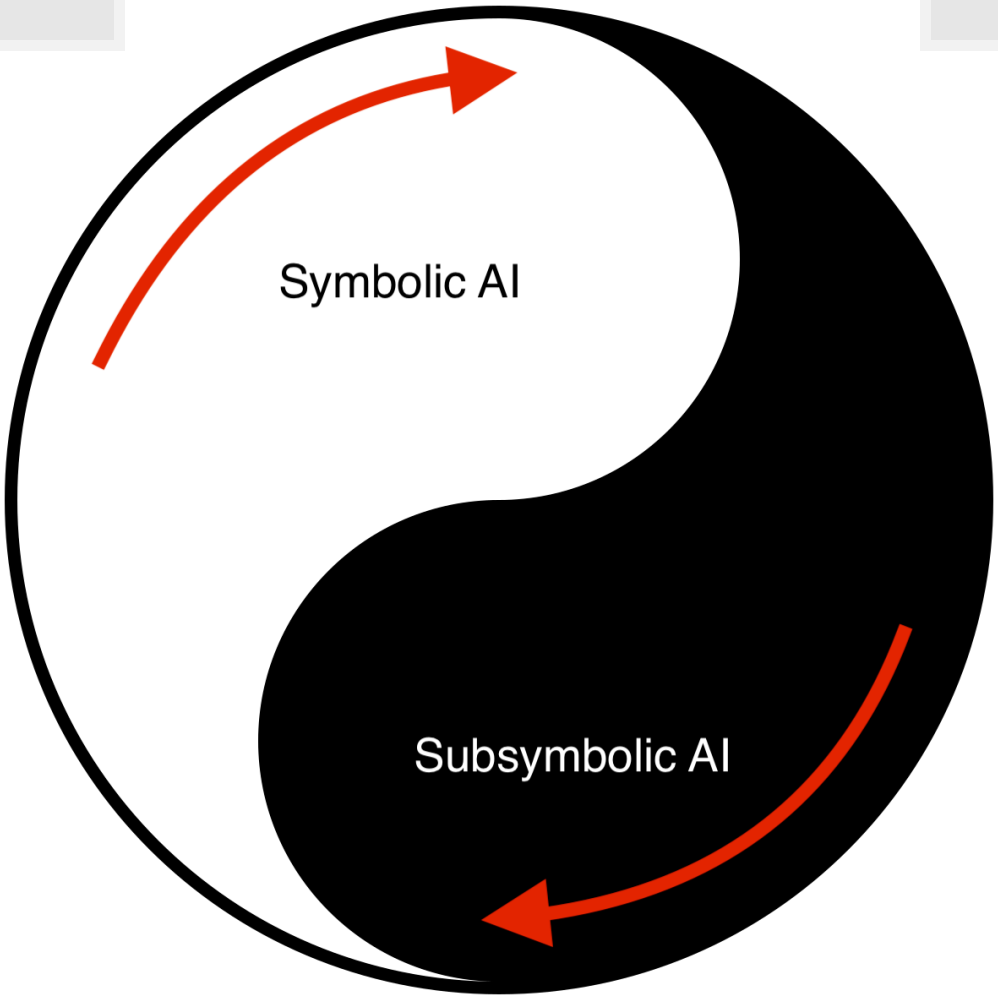


While many sharp minds are already rethinking!

Yin und Yang der KI — The Next (really) Big Thing?!

Causalities
Abstraction
Precise Reasoning
Explain-/Verifiability
...

Correlations
Patterns
Robustness
Learning
...



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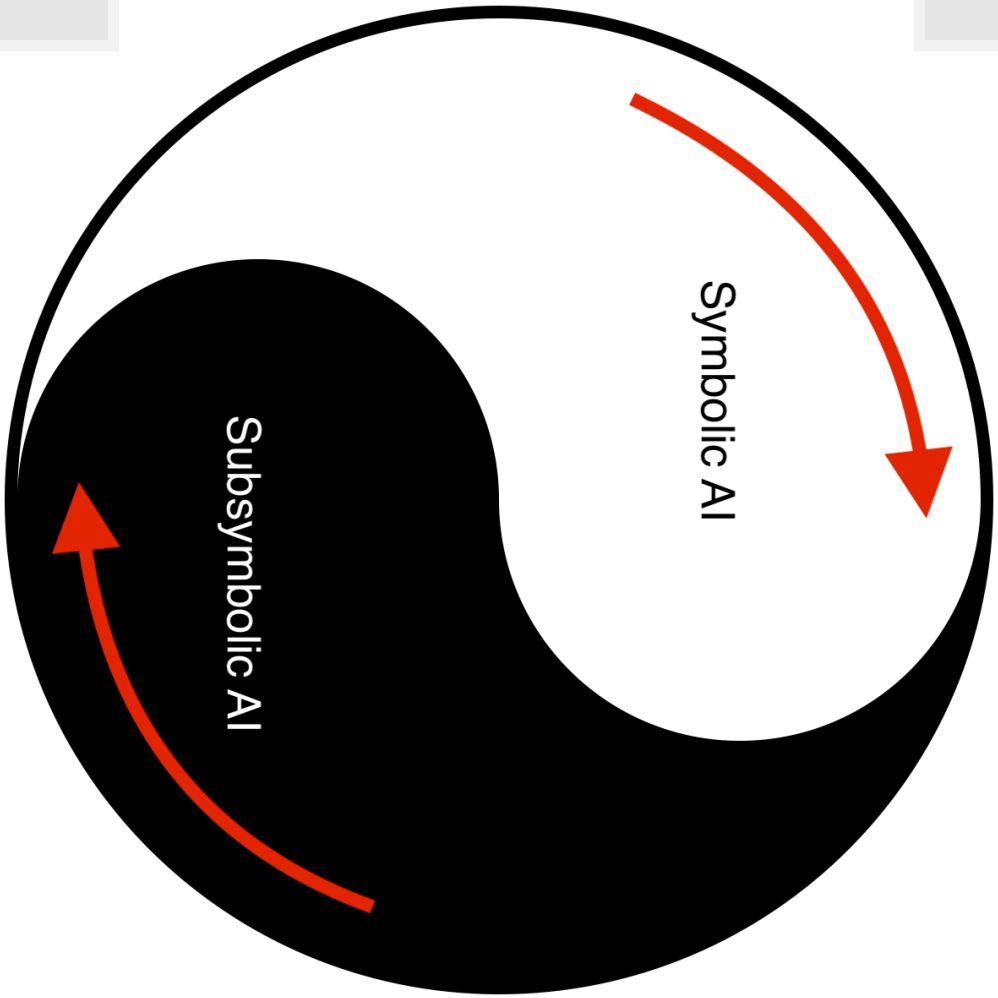

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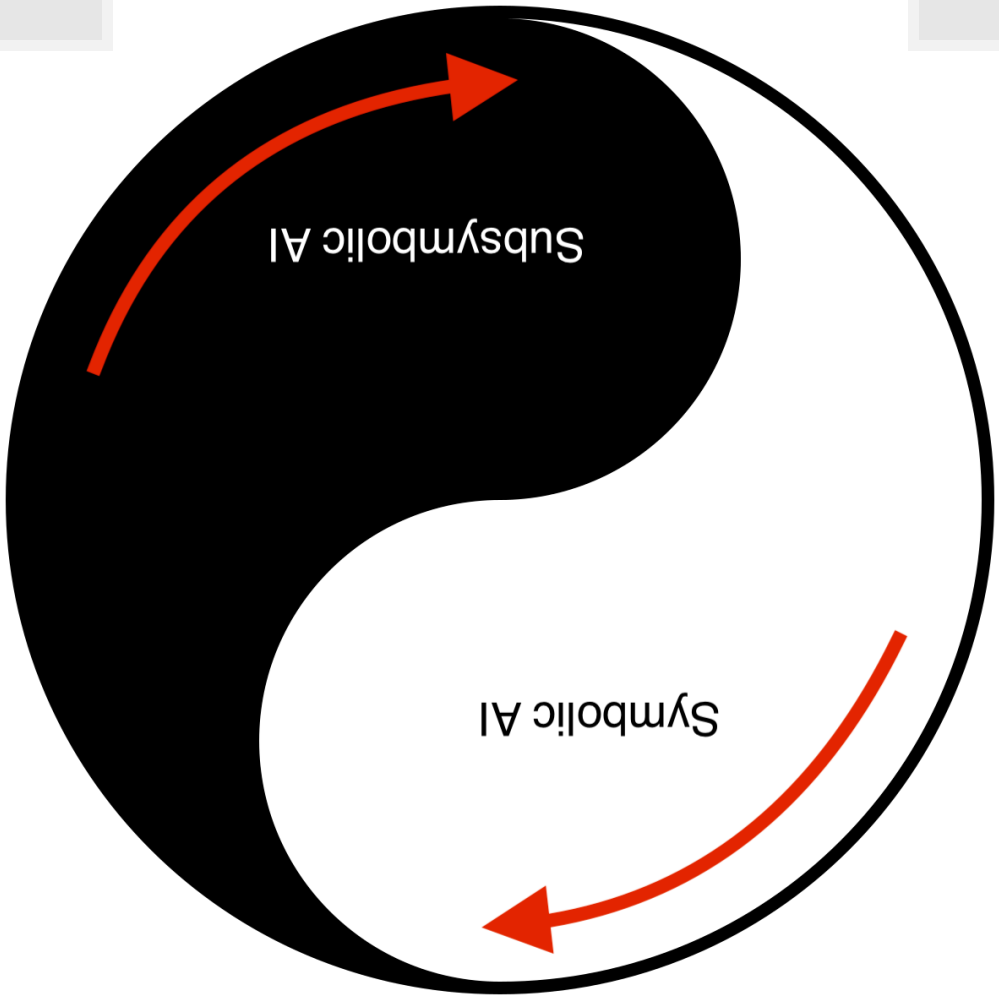

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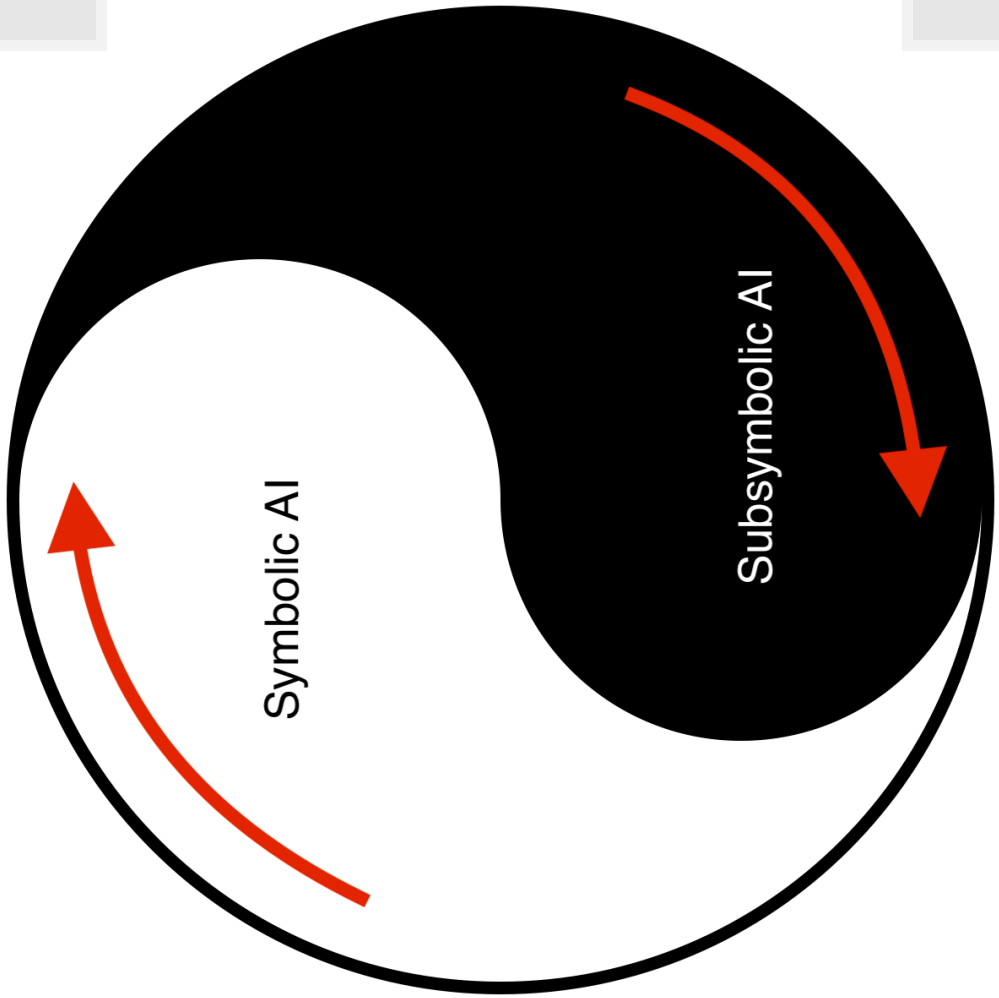
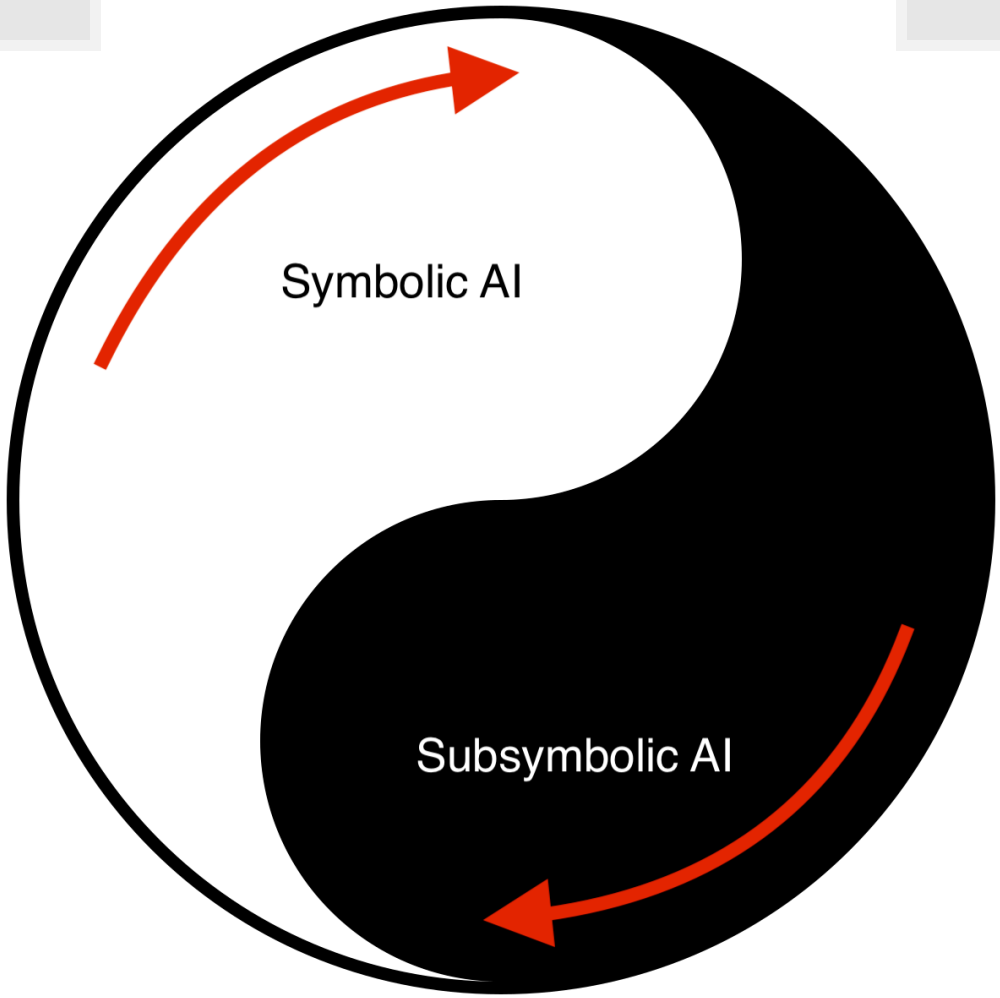
Learning
...



Yin und Yang der KI — The Next (really) Big Thing?!

Causalities
Abstraction
Precise Reasoning
Explain-/Verifiability
...

Correlations
Patterns
Robustness
Learning
...



How to create trust & how to control?

How to create trust?

English title: “Rebel Without a Cause” (1955)

How to create trust?

English title: “Rebel Without a Cause”

- Do our current AI systems know what they are doing?
- Do we know what we are doing when we entrust such AI systems with increasingly critical decisions?
- Is normative directionlessness and unpredictability the core character of future AI systems?
- Why should we trust such systems?

How to create trust?

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How to create trust?

- Do our current AI systems know what they are doing?
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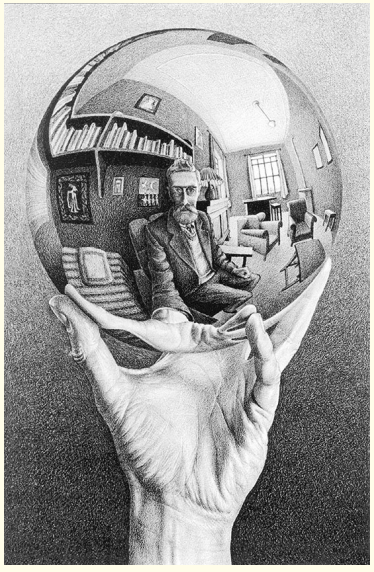
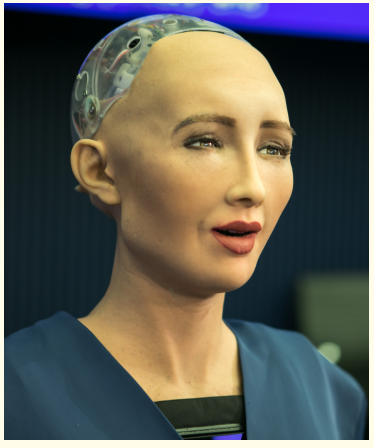


"Hand with Reflecting Sphere (1935)" by M.C. ESCHER.

- We need mature/responsible citizens capable of
- . . . introspection & self-reflection
- . . . engaging in **rational dialogues**
- Do erratic AI systems fit in this picture?
- Are they ready for societal integration?
- First, we need to create trust!

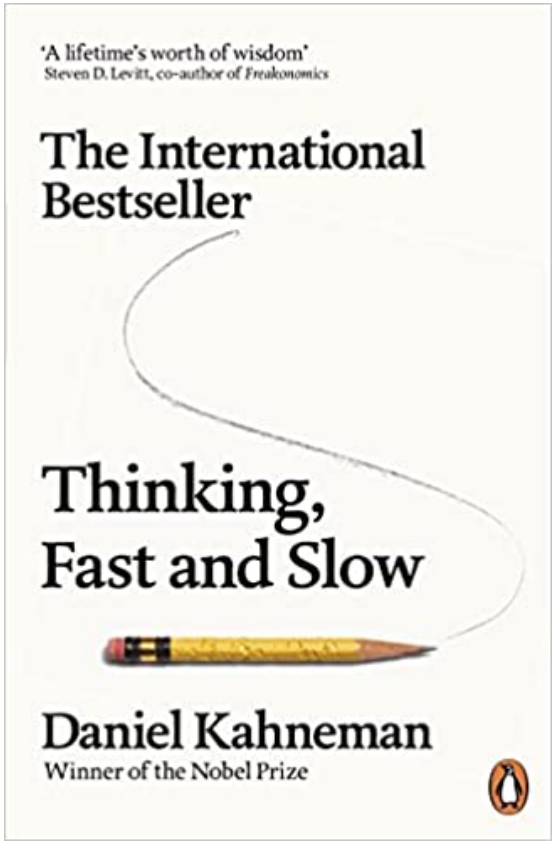


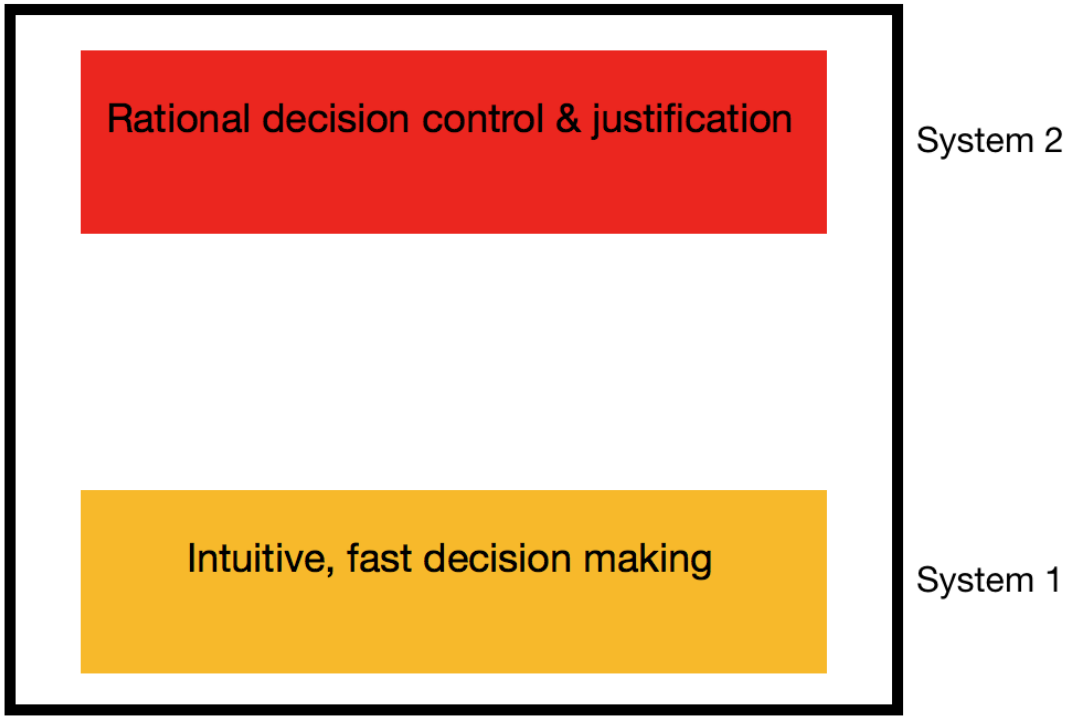
Humanoid "Sophia"

systems?

English title: "Rebel Without a Cause"

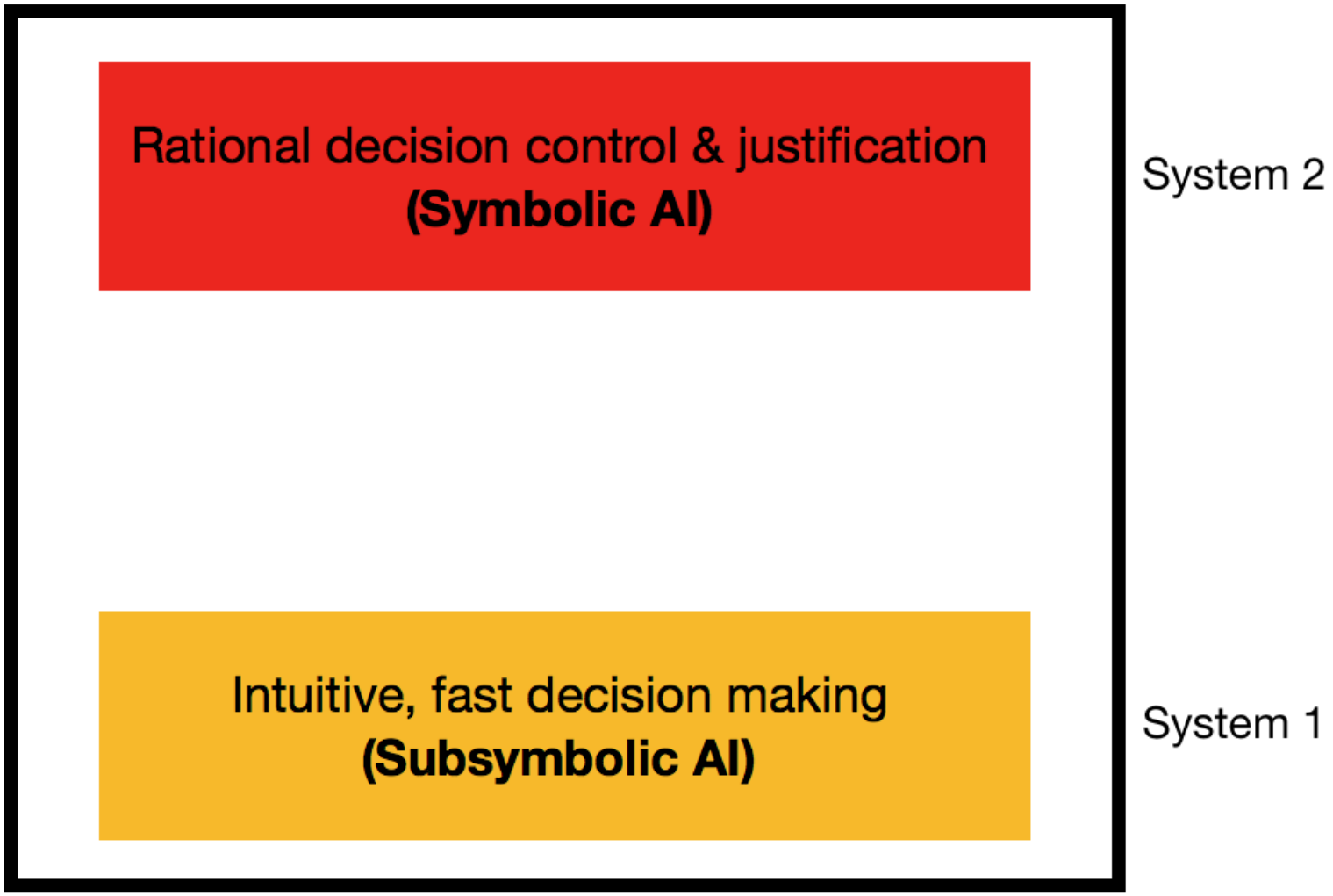
How to create trust? How to control?



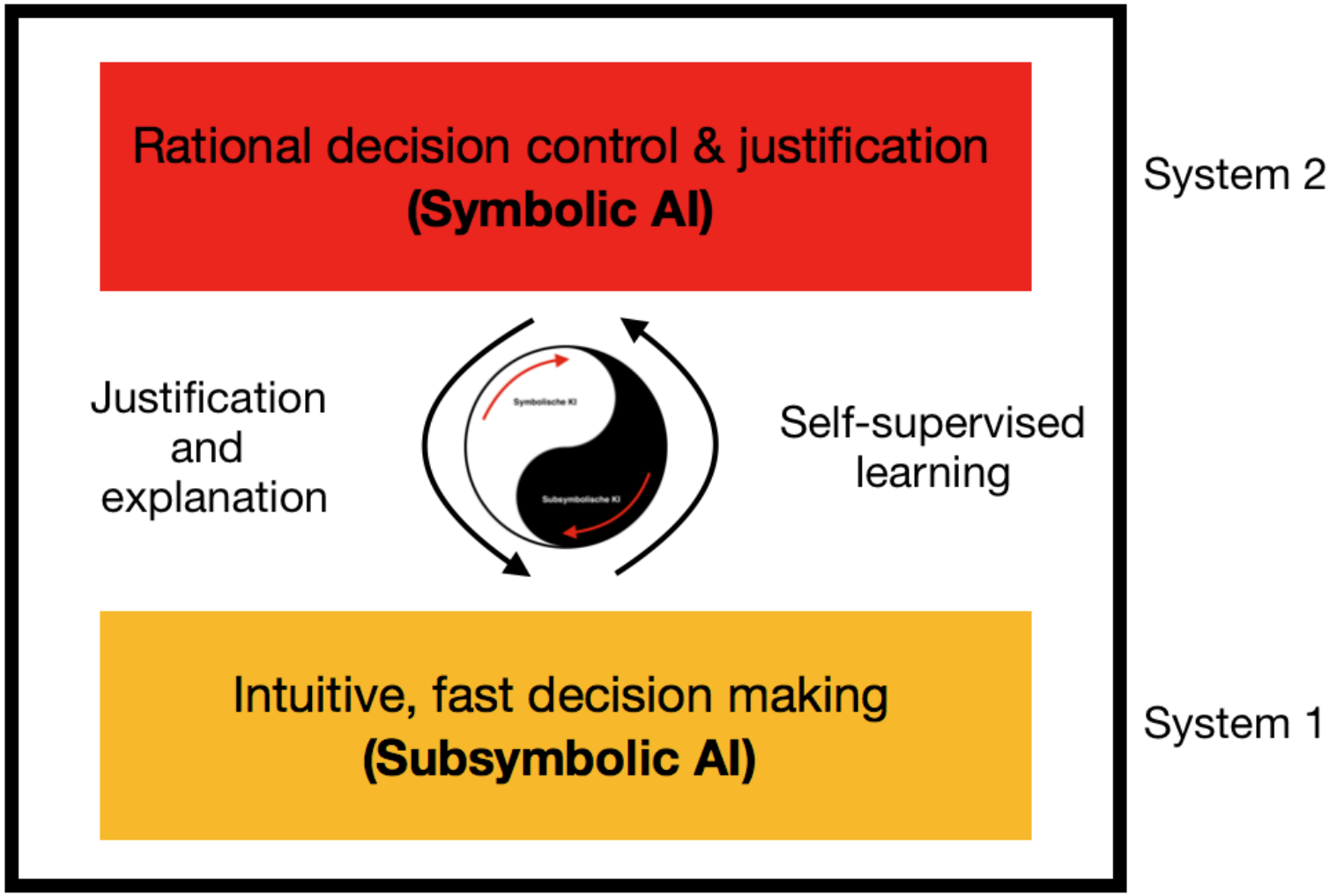


See e.g. also: **J. Haidt, The Emotional Dog and its Rational Tail, 2001**

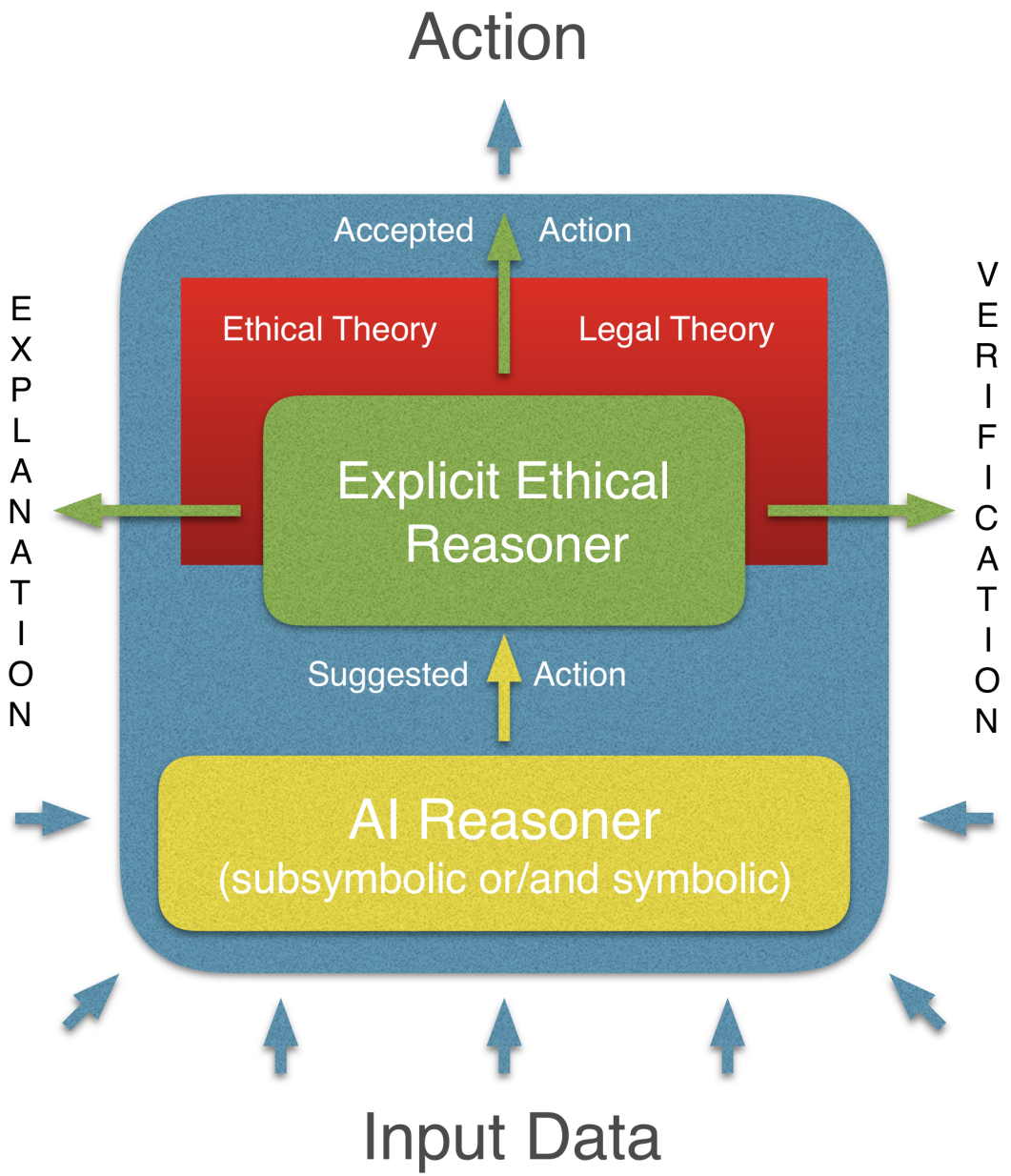
How to create trust? How to control?



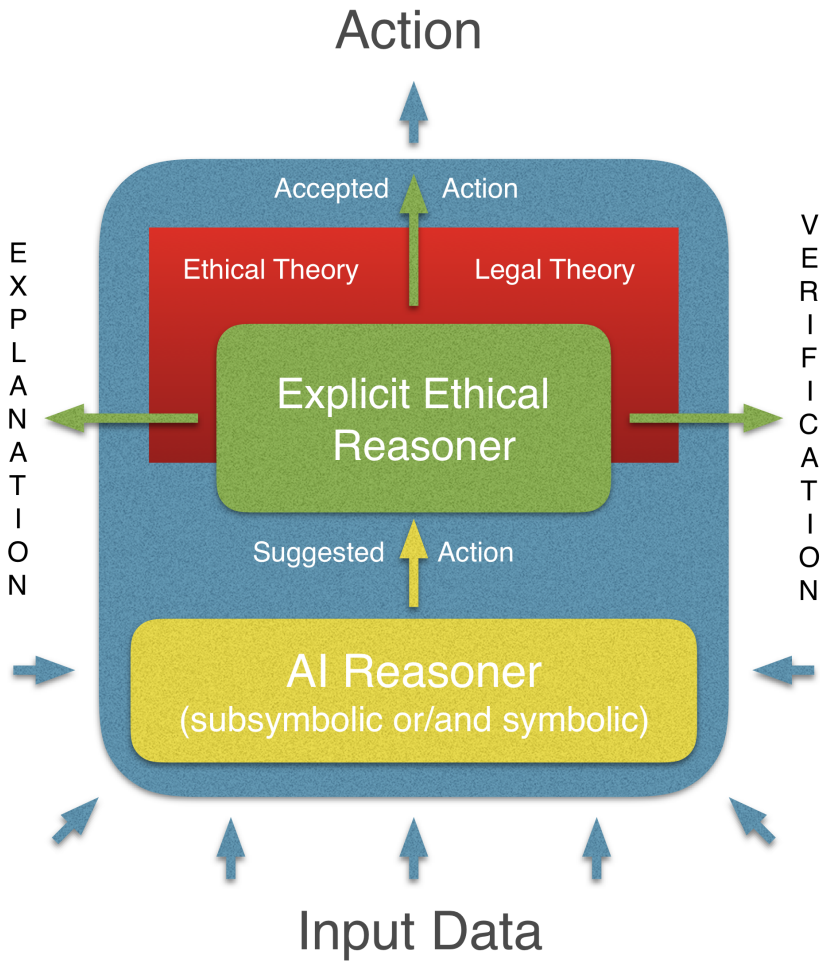
How to create trust? How to control?



How to control? Pseudo-Ethical AI Agent



How to control? Pseudo-Ethical AI Agent



Related Works

- Toward Ethical Robots
  - [ArkoudasEtAl., 2005]
- Artificial Moral Agents
  - [Wallach&Allen, 2008]
- Ethical Governors
  - [ArkinEtAl., 2009, 2012]
  - [Dennis&Fisher, 2017]
- Ethical Deliberation in ART
  - [Dignum, 2017]
- Programming Machine Ethics
  - [Pereira&Saptawijaya, 2016]

Addresses demands for explainability and verifiability:
⇒ but not at the level of AI black box systems!

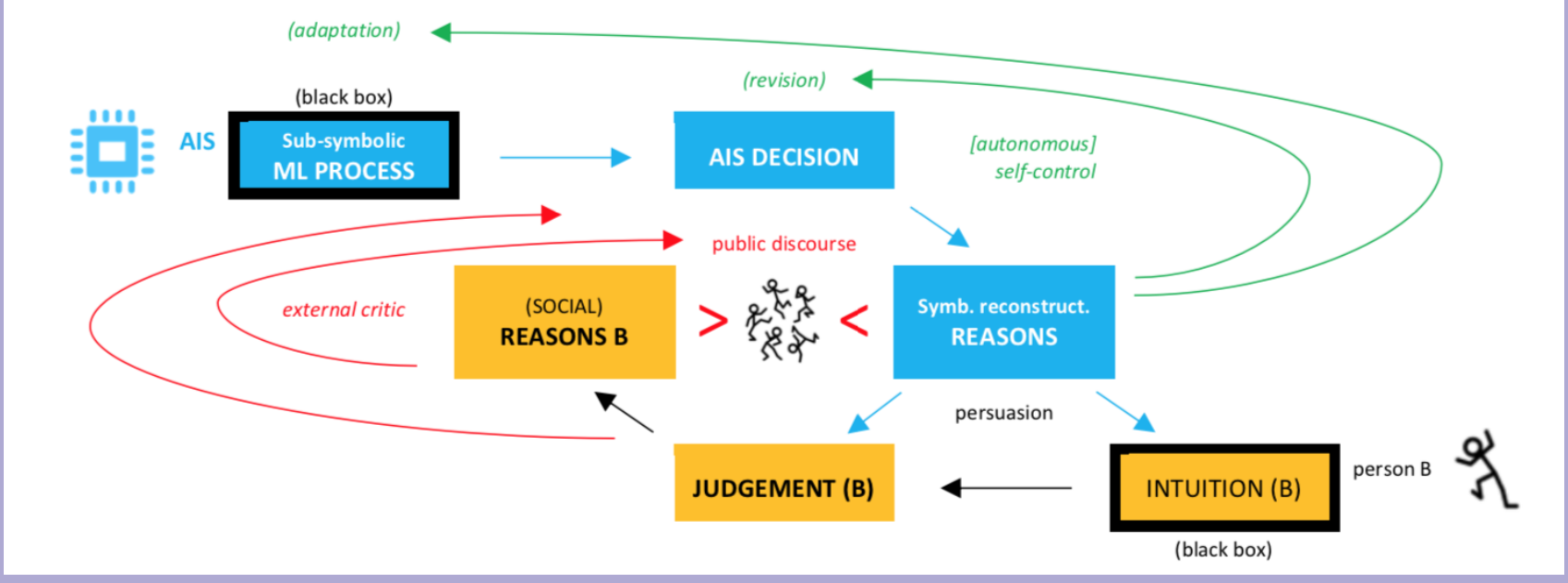
German Conference on Artificial Intelligence (Künstliche Intelligenz)

KI 2020: KI 2020: Advances in Artificial Intelligence pp 251-258 | Cite as

Reasonable Machines: A Research Manifesto

Christoph Benzmüller , Bertram Lomfeld

Artificial "Social Reasoning Model"

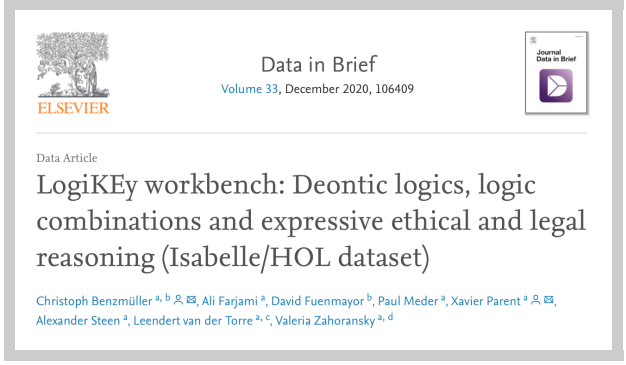


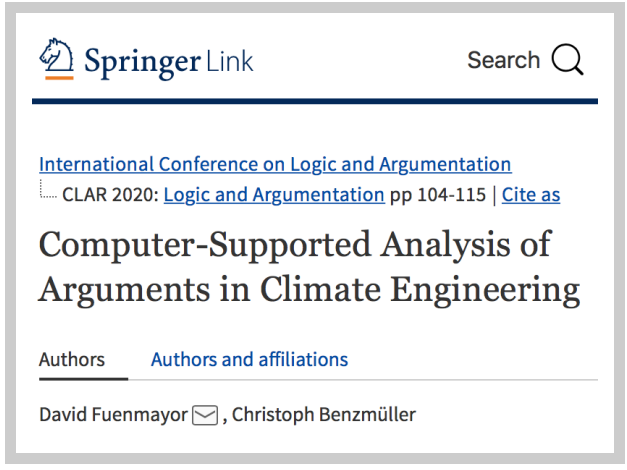
Building trust into AI systems through rational communication of »reasons«

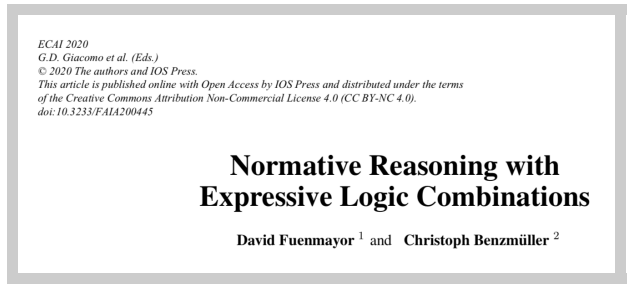
Important:

- these reasons may actually be independent of the original motivational impulse to act
- should be possible to avoid opening the black-box, since this can increase vulnerability

Recent Research Focus: Experiments in expressive, symbolic KR&R in the fields of ethics and law



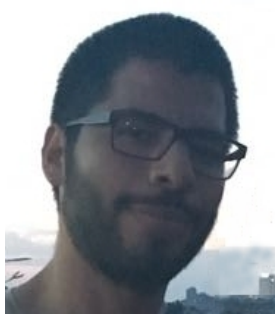




(some recent papers)



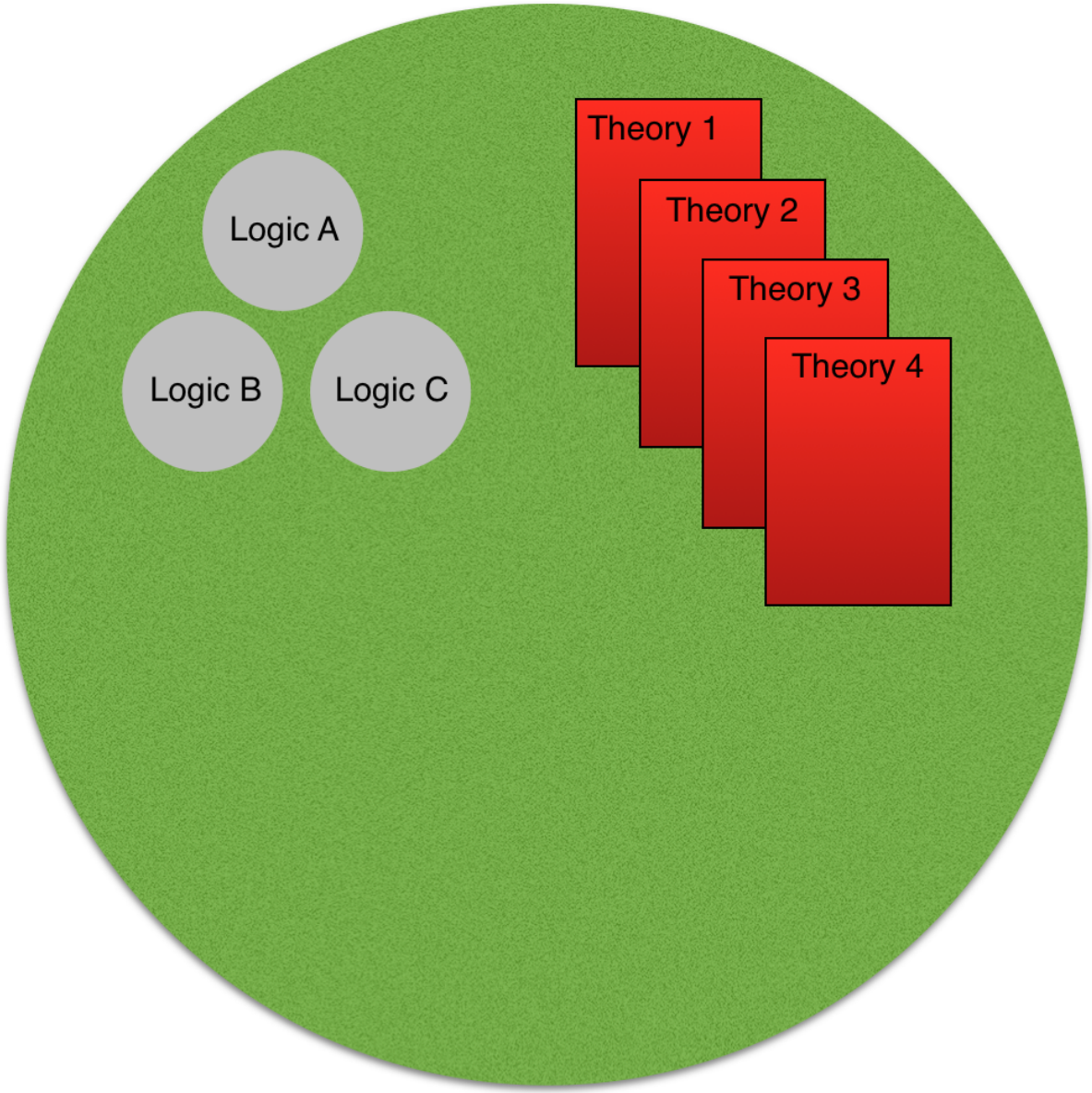





Normative Reasoning Experimentation Framework

(proposed in 2018 DEON keynote and much further developed since then)

[AIJ (2020) vol. 287], [Data in Brief (2020) vol. 33], `www.logikey.org`



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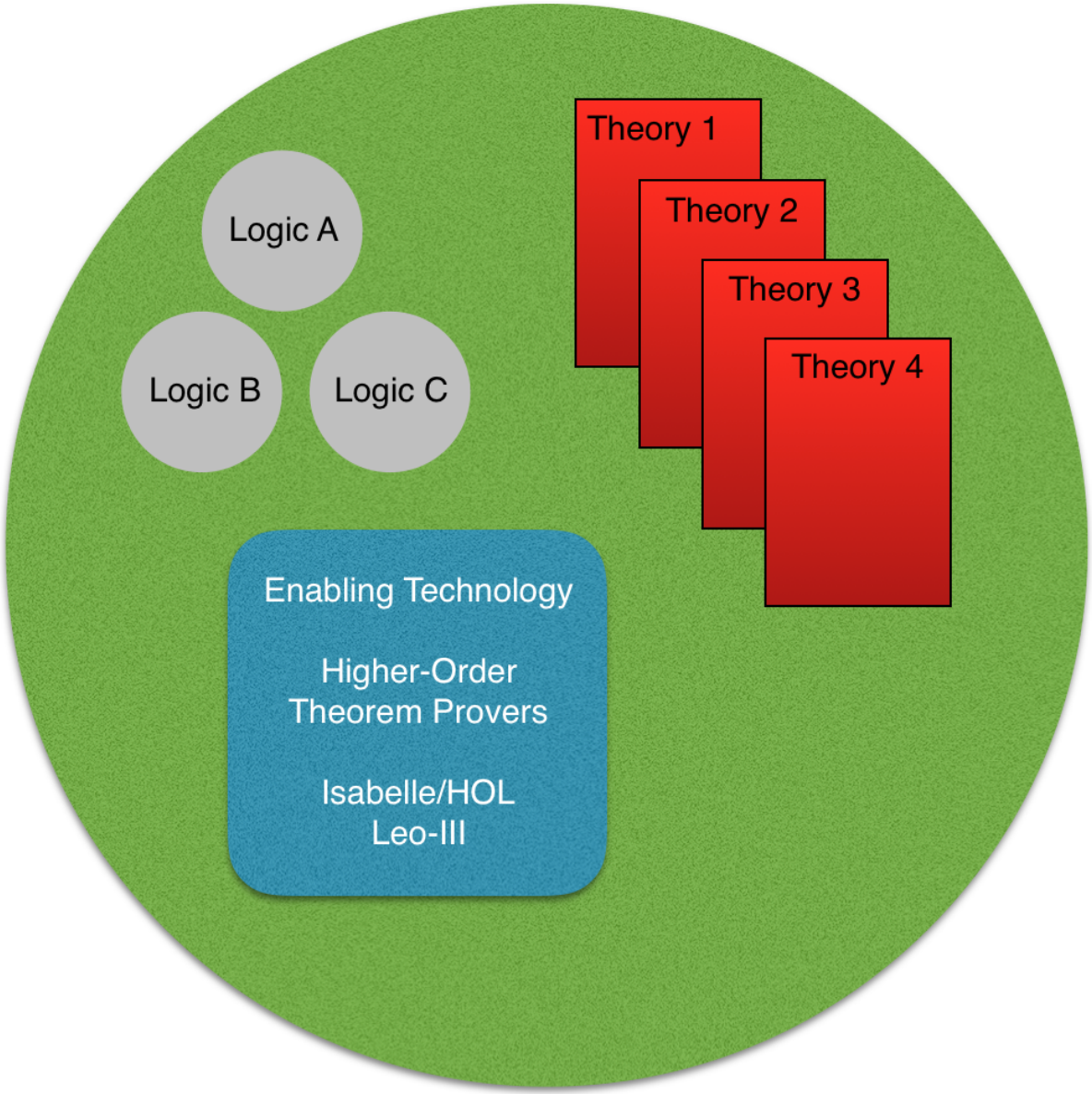

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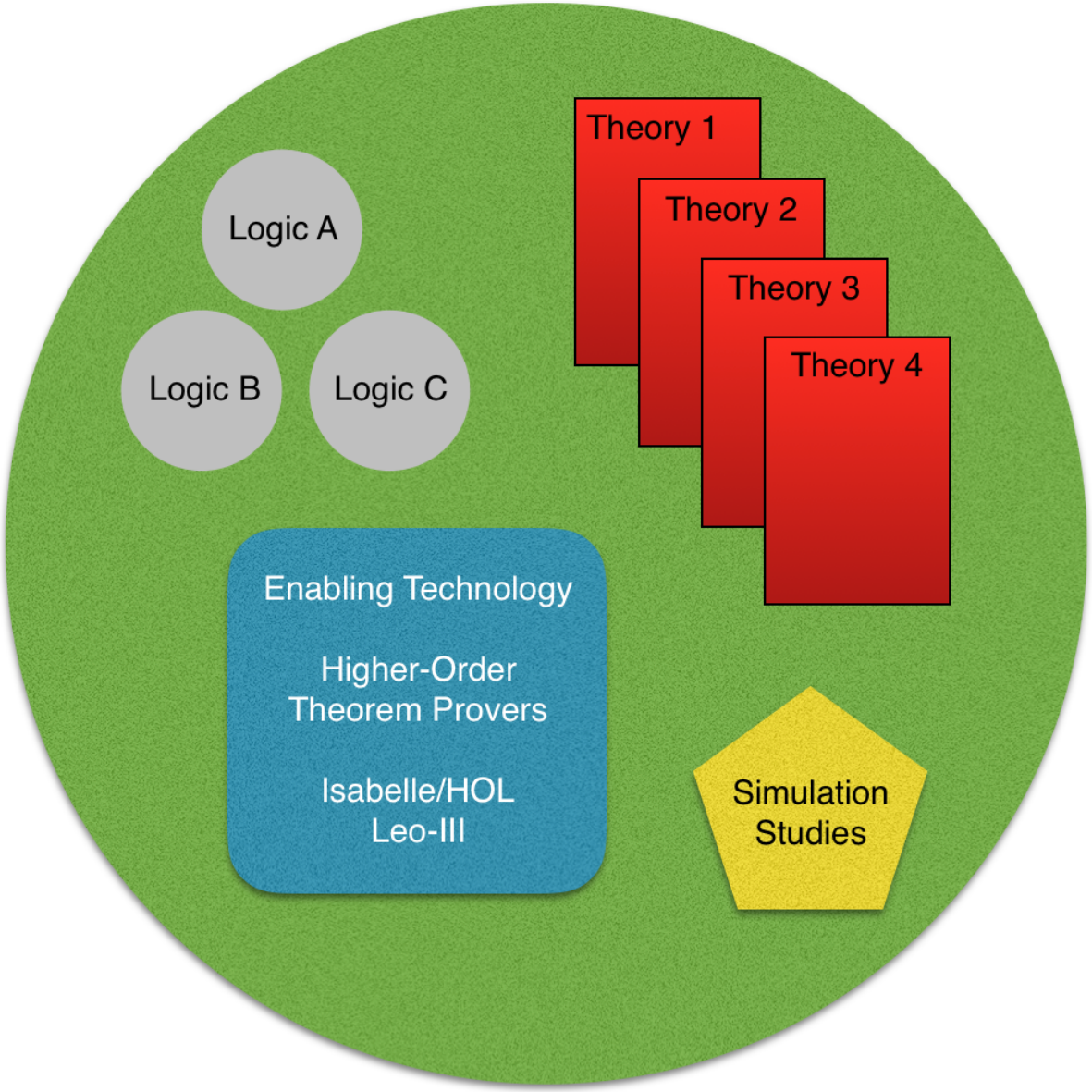


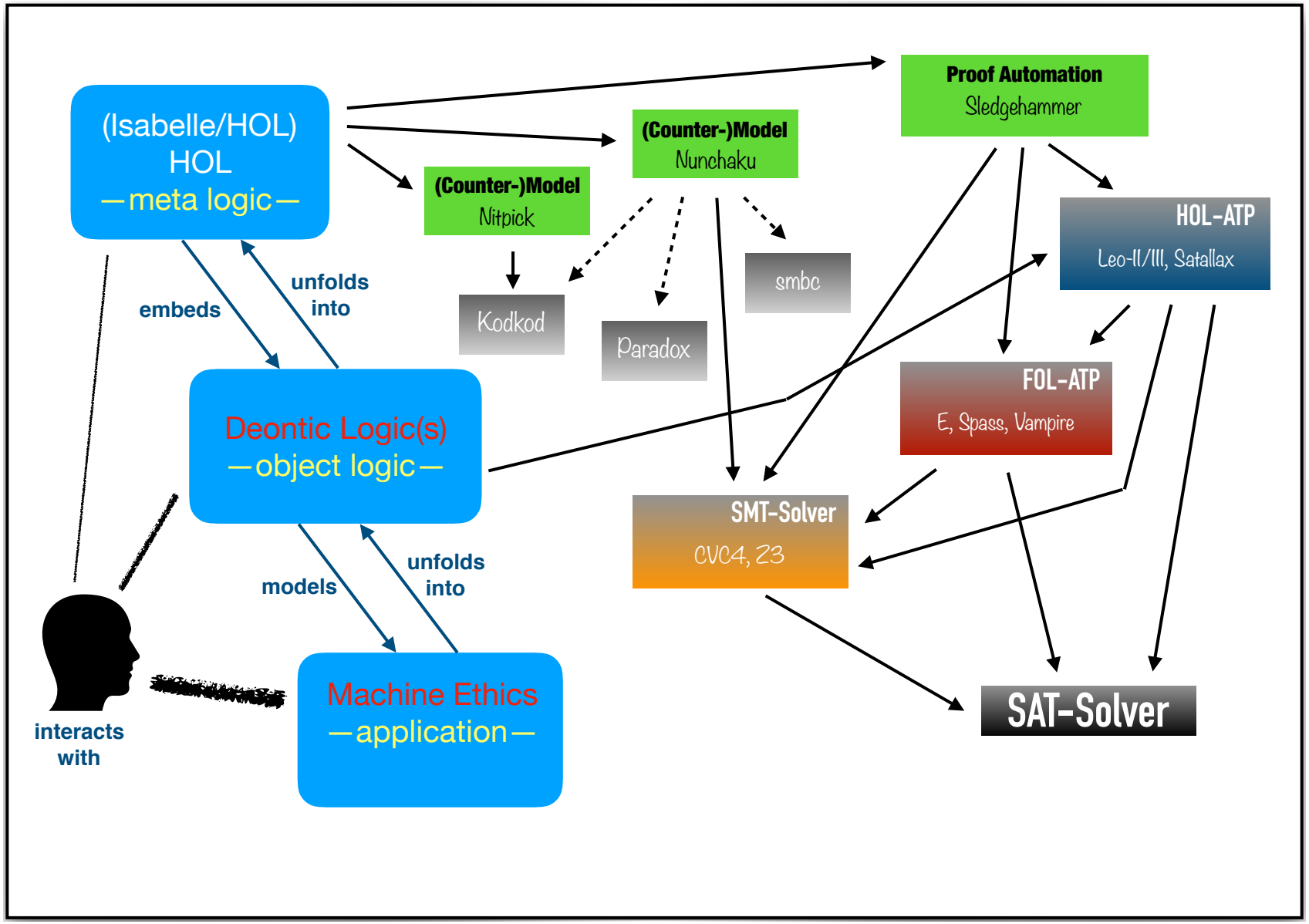
Universal (Meta-)Logical Reasoning in HOL

[SciCompProgr (2019) vol. 172]

How to Tame the Logic Zoo?

Universal (Meta-)Logical Reasoning in HOL

[SciCompProgr (2019) vol. 172]



ELSEVIER

Artificial Intelligence

Volume 287, October 2020, 103348

Designing normative theories for ethical and legal reasoning: LogiKEy framework, methodology, and tool support ☆

Christoph Benzmüller [b, a], Xavier Parent [a], Leendert van der Torre [a, c]

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https://doi.org/10.1016/j.artint.2020.103348

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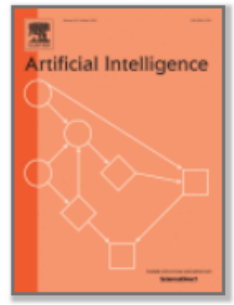
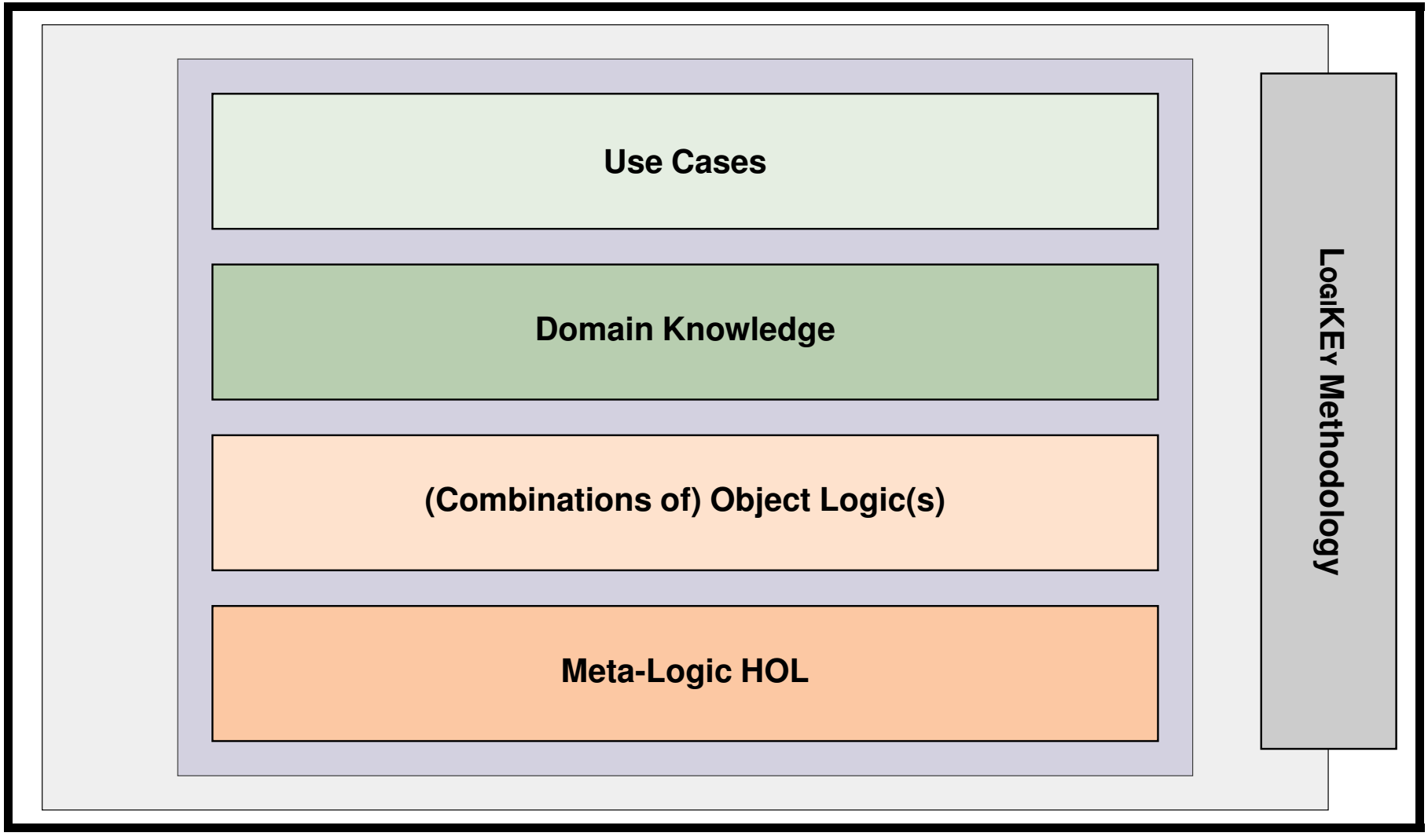
Artificial Intelligence

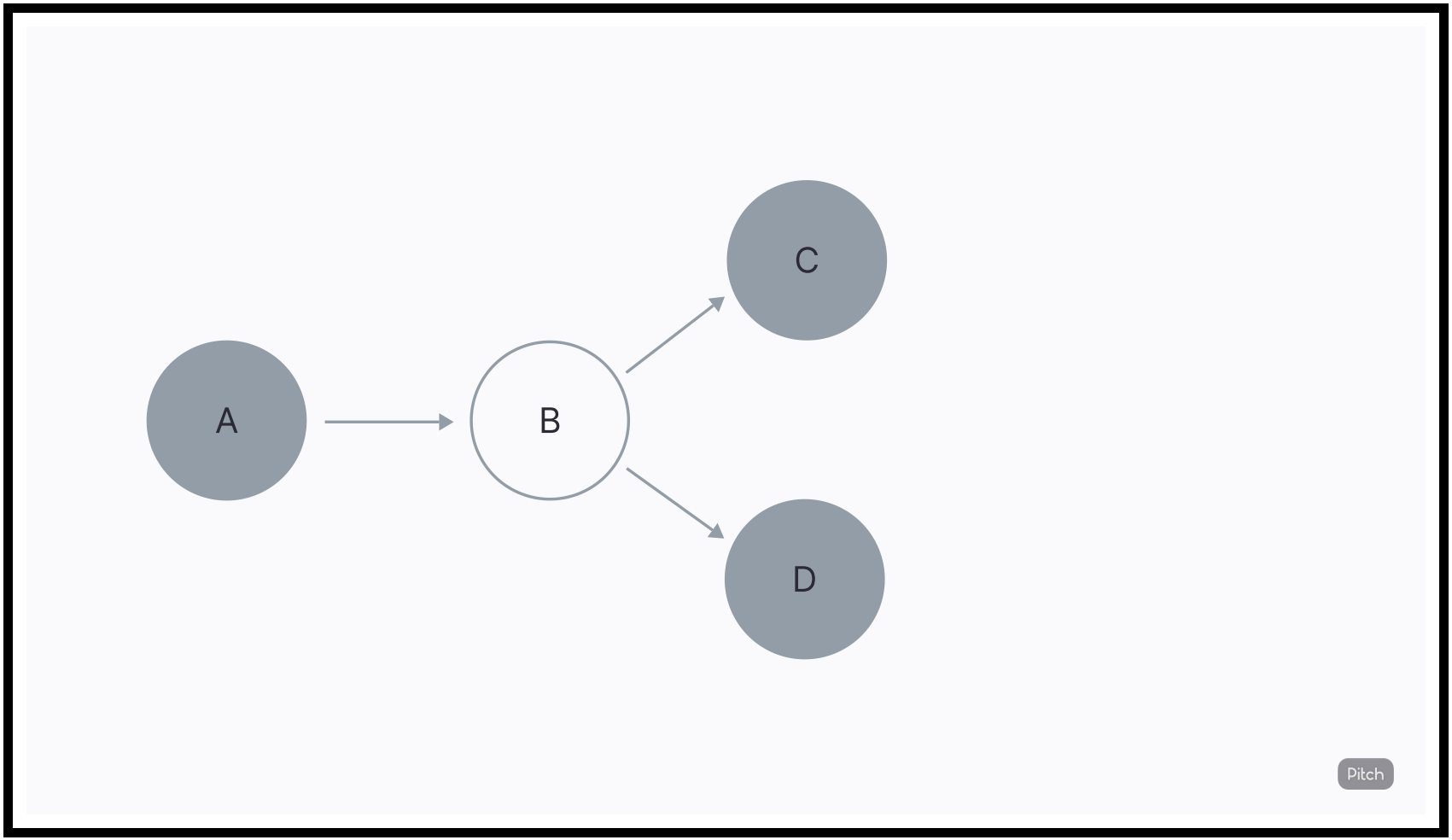
Volume 287, October 2020, 103348





LogiKEy and Abstract Argumentation?

[CLAR (2020)], [CLAR (2018)], [MBR (2018)]



Research goal: Show that the LogiKEy framework supports
pluralistic semantics

LogiKEy and Abstract Argumentation?

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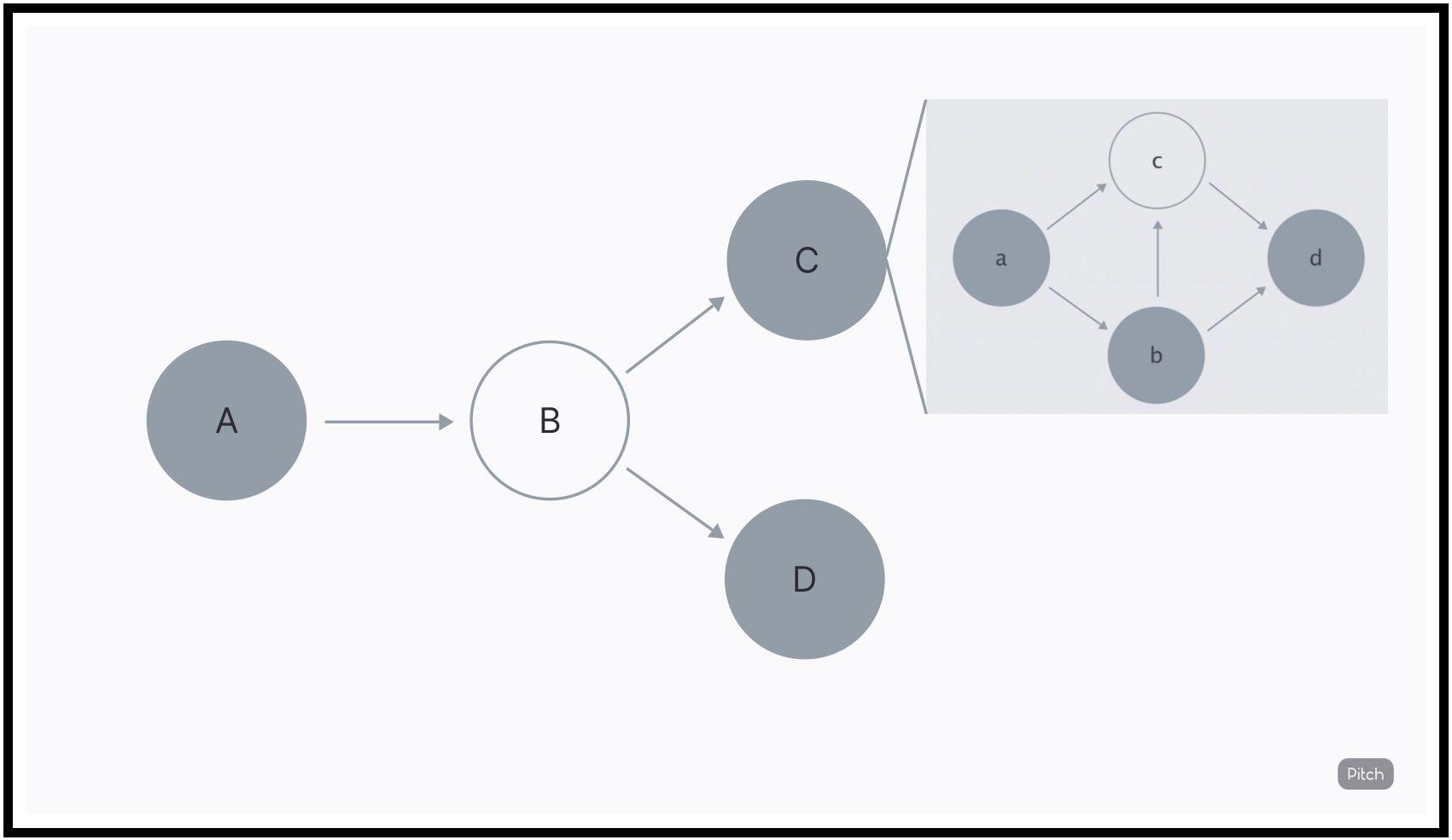

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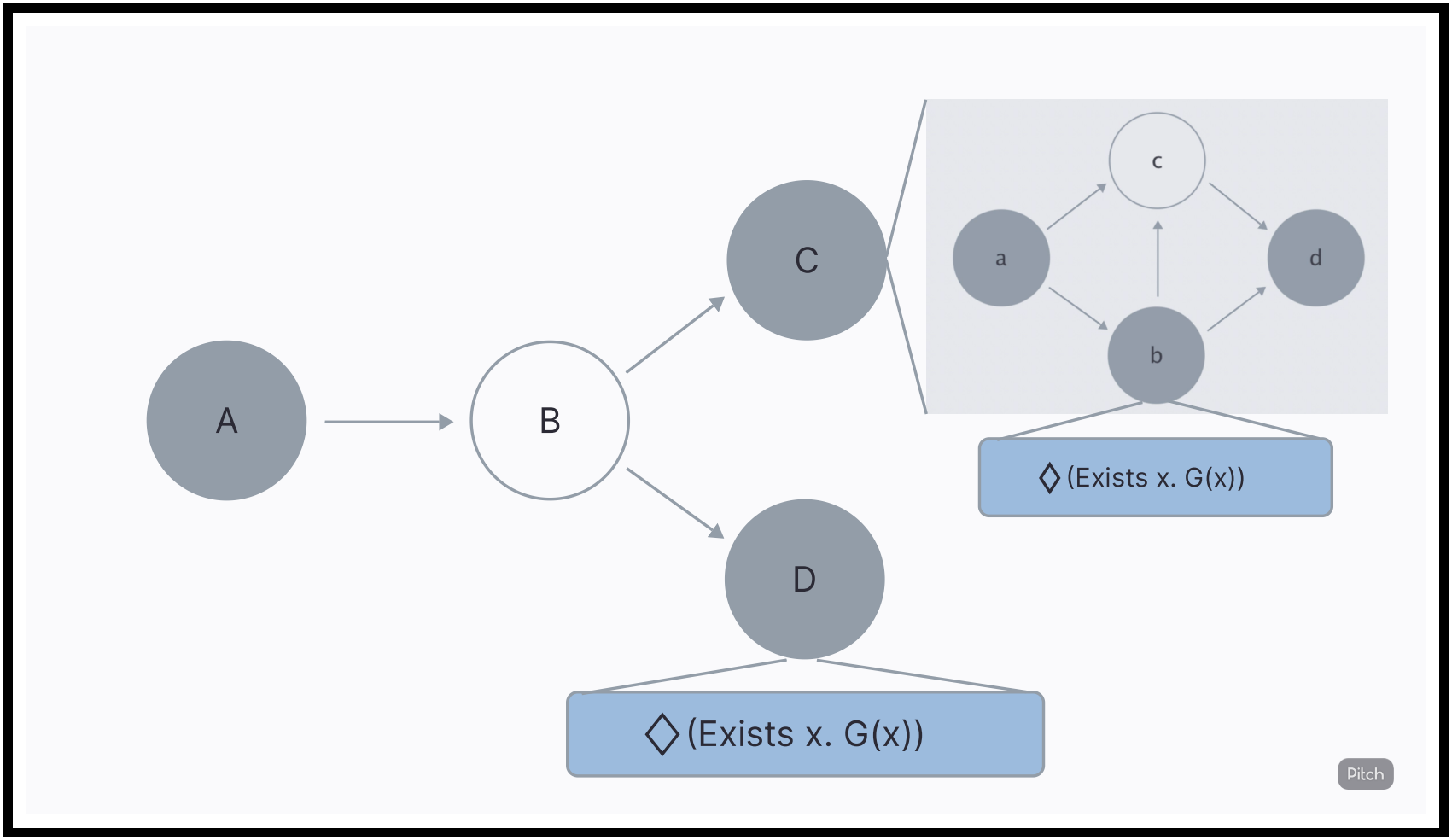
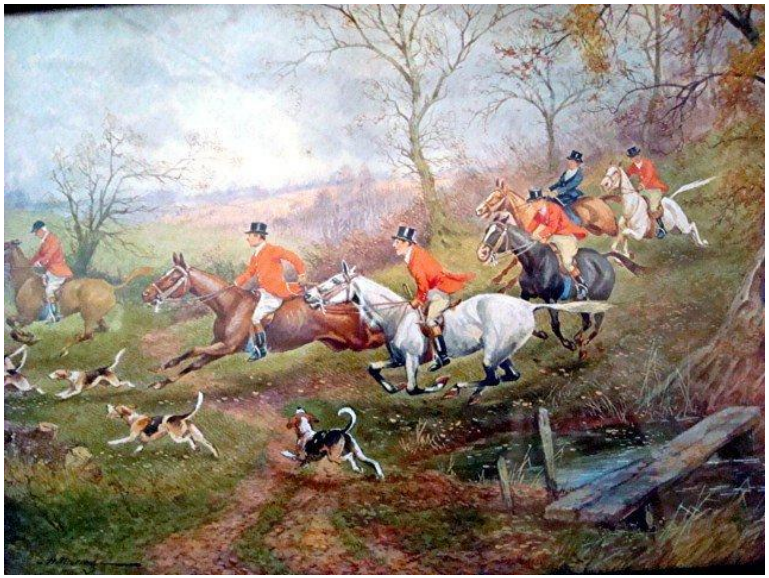


Research goal: Show that the LogiKEy framework supports

pluralistic semantics | nested arguments | nodes with complex formulas

LogiKEy and Legal Balancing?

For example, Wild Animal Court Cases — [MLR@KR (2020)]



Post, a fox hunter, was chasing a fox through public land when Pierson came across the fox and, knowing it was being chased, killed the fox and took it away. Post sued Pierson for damages against his possession of the fox. Post argued that giving chase to the fox was sufficient to establish possession.

- A local court first ruled in favour of Post
- Pierson appealed, decision was changed

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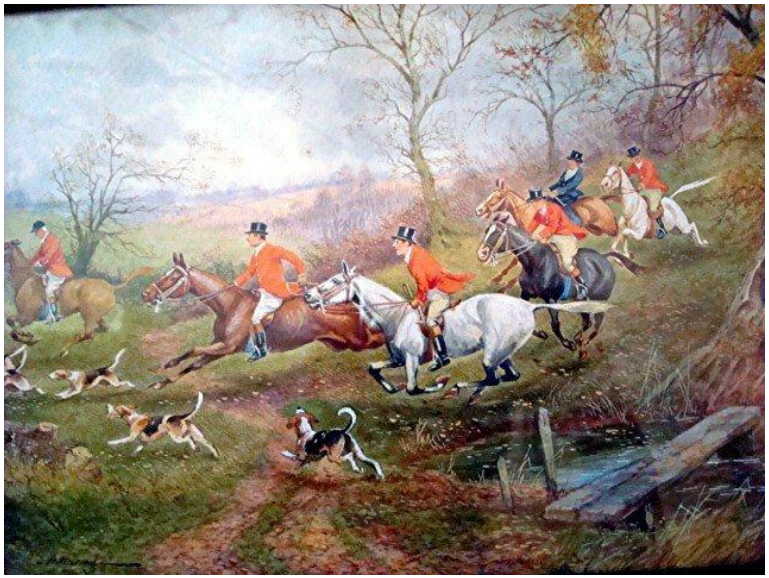

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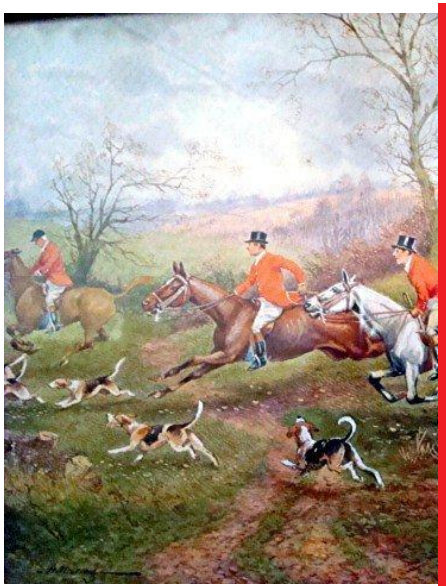
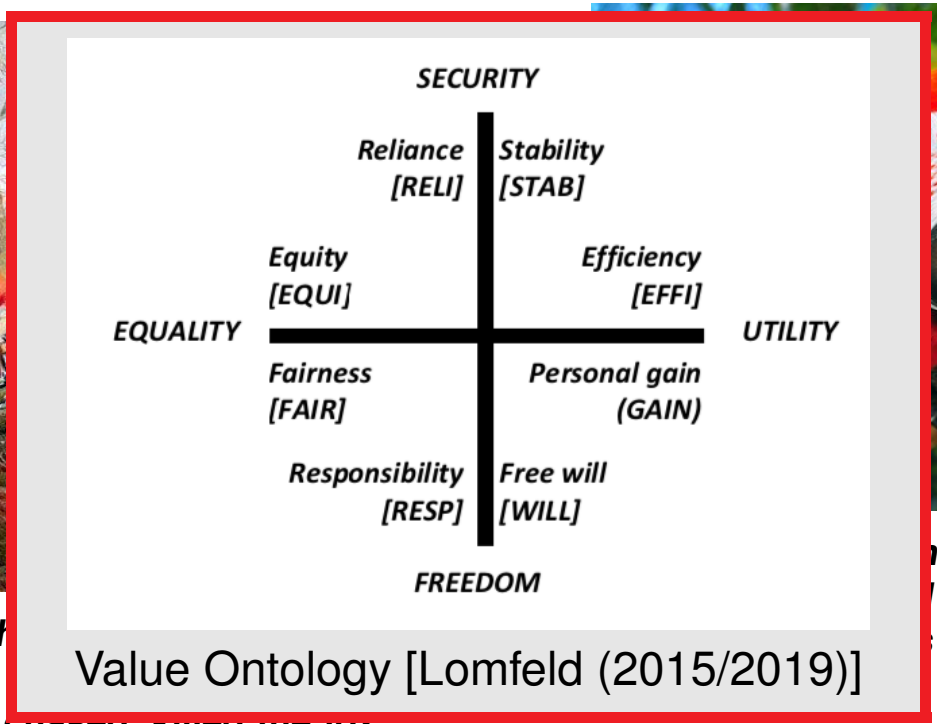
Chester, a parrot owned by the ASPCA (animal shelter), escaped and was recaptured by Conti. The ASPCA found this out and reclaimed Chester from Conti.

- Here the court ruled in favour of the ASPCA

LogiKEy and Legal Balancing?

For example, Wild Animal Court Cases — [MLR@KR (2020)]





Value Ontology [Lomfeld (2015/2019)]

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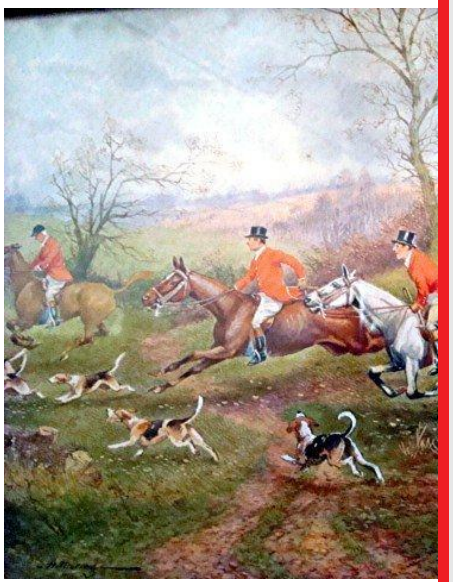

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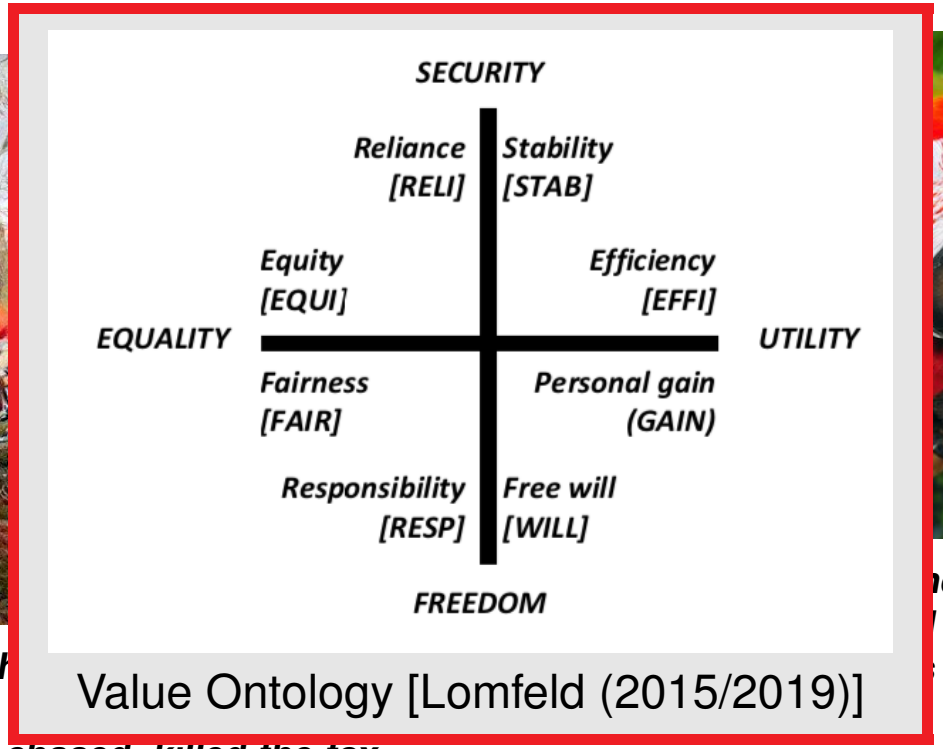
- Pierson appealed, decision was changed
- The decision in favour of Pierson implies: legal **STAB**ility > **WILL** to possess



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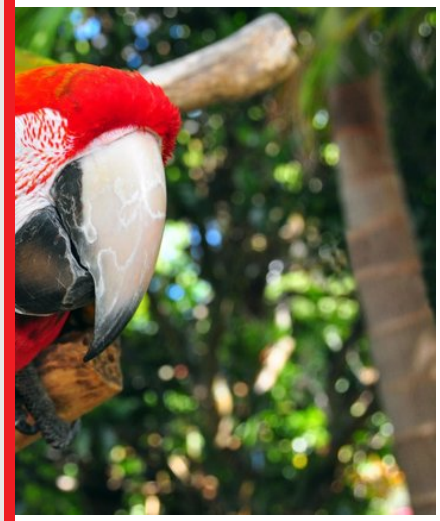

…ed by the ASPCA (animal … was recaptured by Conti. … out and reclaimed Chester

- Here the court ruled in favour of the ASPCA
- For **domestic animals** value preference **STAB**ility > **WILL** does not apply
- For a **domestic animal** it is sufficient that owner did not give up the **RESP**onsability for its maintenance
- **RESP** together with ASPCA's **RELI**ance in the parrot's property > Conti's corporal possession (**STAB**) of the animal

LogiKEy and Legal Balancing?

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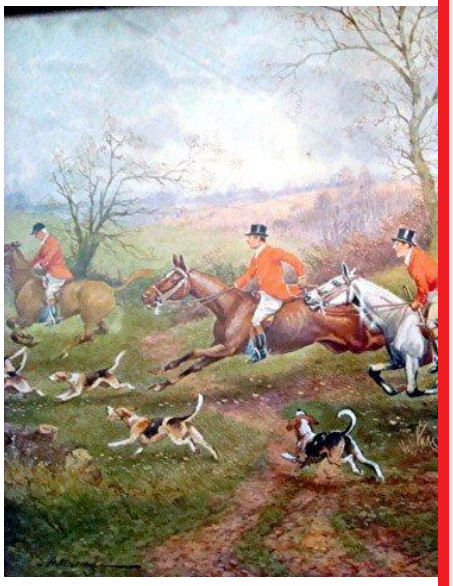

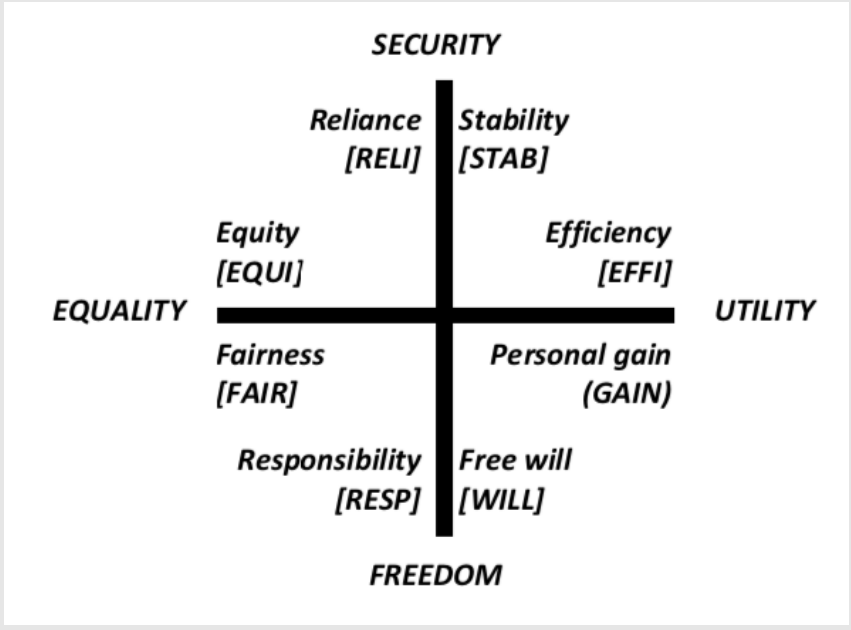

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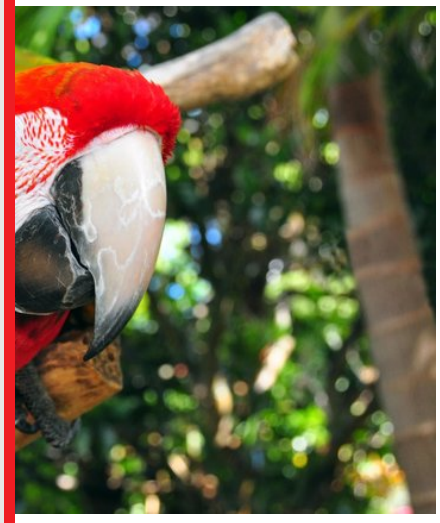

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against his posse
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```
R1: "⌊appAnimal ⟶ (STAB^p ≺v STAB^d)⌋" and
R2: "⌊appWildAnimal ⟶ (WILL^(x-1) ≺v STAB^x)⌋" and
R3: "⌊appDomAnimal  ⟶ (STAB^(x-1) ≺v RELI^x⊕RESP^x)⌋"
abbreviation "Pierson_facts ≡ ⌊Fox α ∧ (FreeRoaming α) ∧
  (¬Pet α) ∧ Pursue p α ∧ (¬Pursue d α) ∧ Capture d α⌋"
theorem assumes Pierson_facts shows "⌊For p ≺ For d⌋"
  by (metis assms CW1 CW2 W6 W8 ForAx R2 F1 other.simps(2) rBR)
```

- A local court
- Pierson appe
- The decision in favour of Pierson implies: legal **STAB**ility > **WILL** to possess

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e preference

apply

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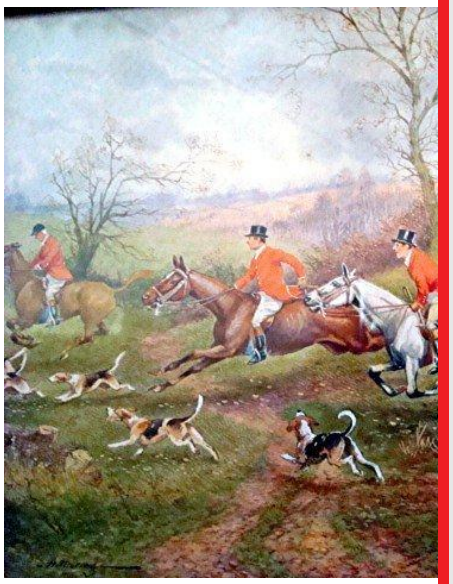
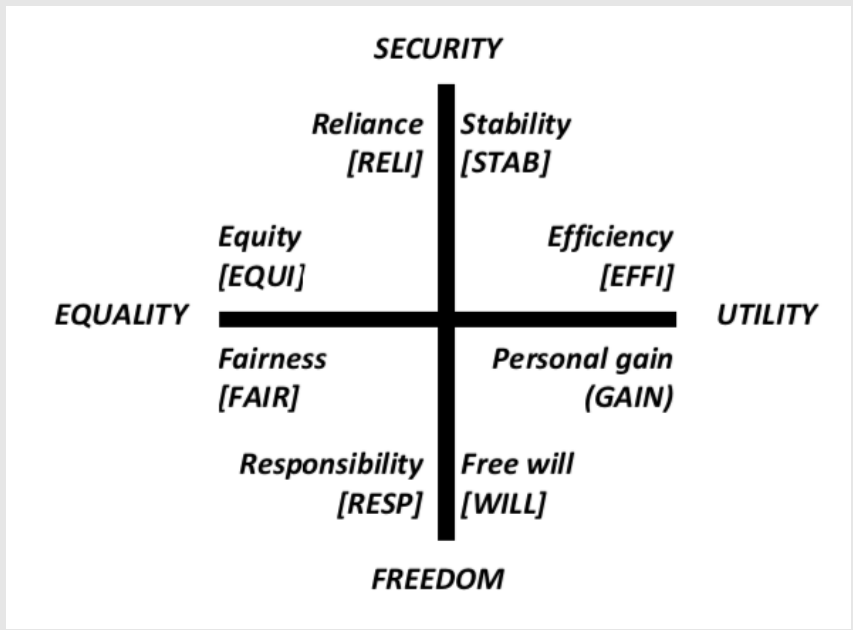
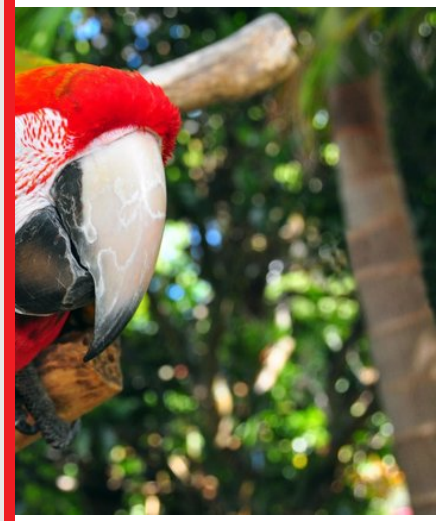




Value Ontology [Lomfeld (2015/2019)]



Post, a fox hunter, was ch
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and, knowing it w
and took it away.
against his posse
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tablish possessio

- A local court
- Pierson appe
- The decision
  legal **STAB**ili

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was recaptured by Conti.
out and reclaimed Chester

ur of the ASPCA

e preference
apply

sufficient that
ESPonsability for

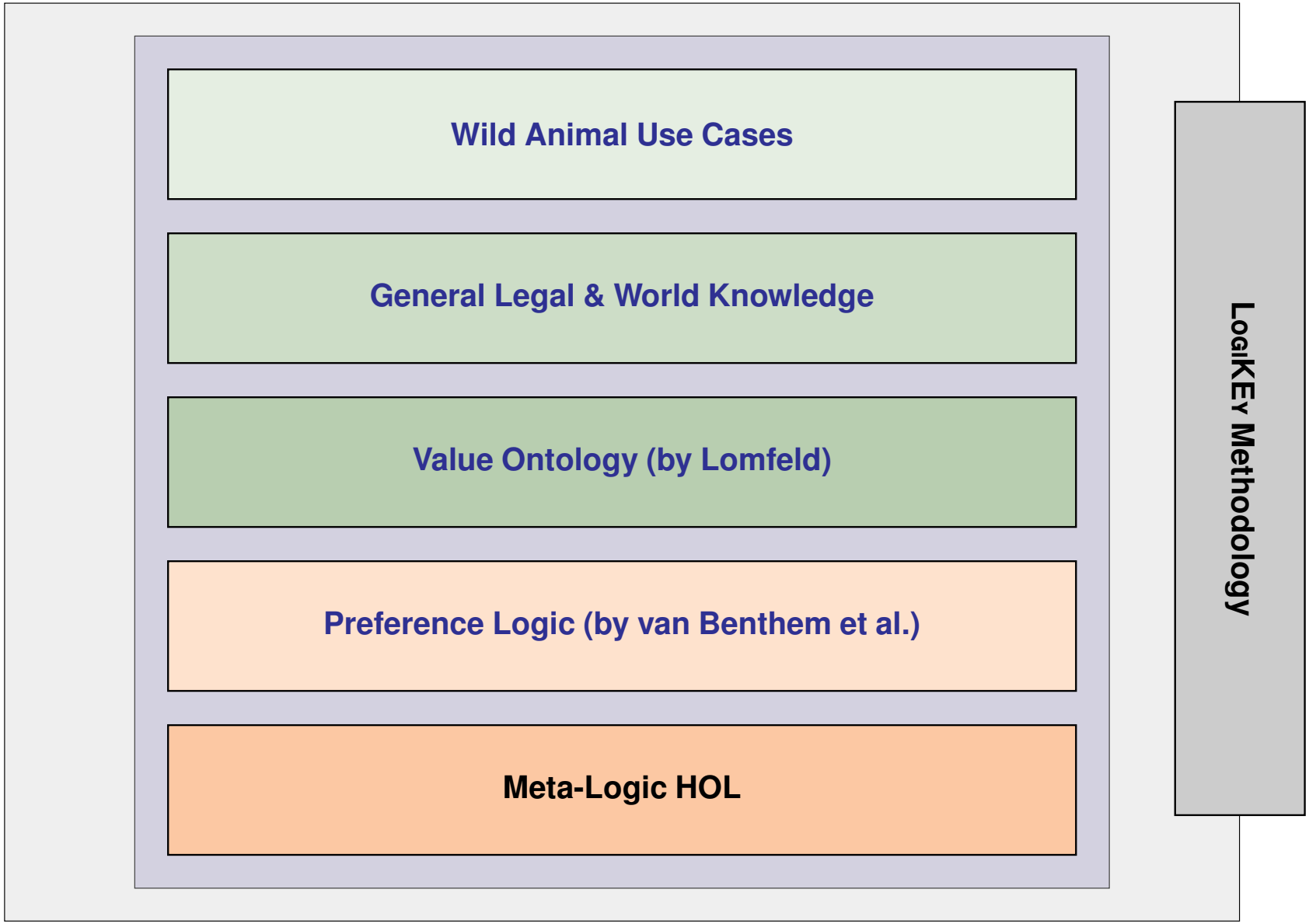
's **RELI**ance in
i's corporal
nimal

```
R1: "⌊appAnimal ⟶ (STAB^p ≺v STAB^d)⌋" and
R2: "⌊appWildAnimal ⟶ (WILL^x-1 ≺v STAB^x)⌋" and
R3: "⌊appDomAnimal  ⟶ (STAB^x-1 ≺v RELI^x⊕RESP^x)⌋"
abbreviation "Pierson_facts ≡ ⌊Fox α ∧ (FreeRoaming α) ∧
  (¬Pet α) ∧ Pursue p α ∧ (¬Pursue d α) ∧ Capture d α⌋"
theorem assumes Pierson_facts shows "⌊For p ≺ For d⌋"
  by (metis assms CW1 CW2 W6 W8 ForAx R2 F1 other.simps(2) rBR)
```

```
abbreviation "ASPCA_facts ≡ ⌊Parrot α ∧ Pet α ∧ Care p α ∧
                  Prop p α ∧ (¬Prop d α) ∧ Capture d α⌋"
lemma aux: assumes ASPCA_facts shows "⌊(STAB^d ≺v RELI^p⊕RESP^p)⌋"
  using CW1 CW2 W7 assms R3 by fastforce
theorem assumes ASPCA_facts shows "⌊For d ≺ For p⌋"
  using assms aux CW5 ForAx F3 other.simps(1) rBR by metis
```

LogiKEy and Legal Balancing

[MLR@KR (2020)]



Conclusion – How to create trust?

Can post-hoc normative reasoning competencies prevent AI systems from going rogue?

- Opening AI black box systems – Really a good Idea?
  - transparency (in case of imperfect systems) will have limited impact on trust
  - could even be seen as an invitation for adversial attacks
- I instead argue for argumentation based harnesses
  - . . . to control and justify decisions
  - they may be independent from encapsulated AI black boxes
  - they may benefit from opening the black box (inside the harness)
  - they may hide sensible information to the outside