The Winter, the Summer and the Summer Dream of AI in Law

The journey of ICAIL conference series from my perspective

Enrico Francesconi

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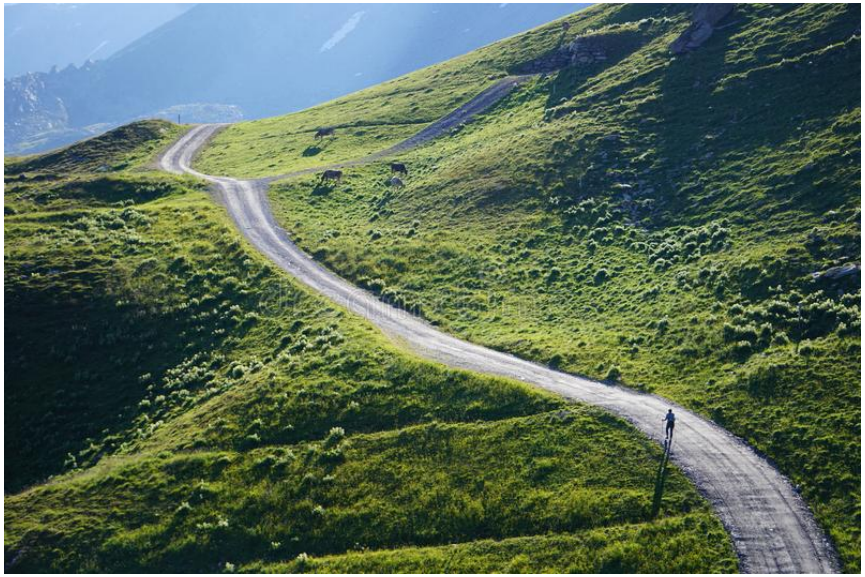
enrico.francesconi@europarl.europa.eu

ICAIL 2021

Long journey of ICAIL conference series from my perspective

My generation joined ICAIL in the early 2000s

- Pioneers in AI&Law have already established the foundations of the discipline



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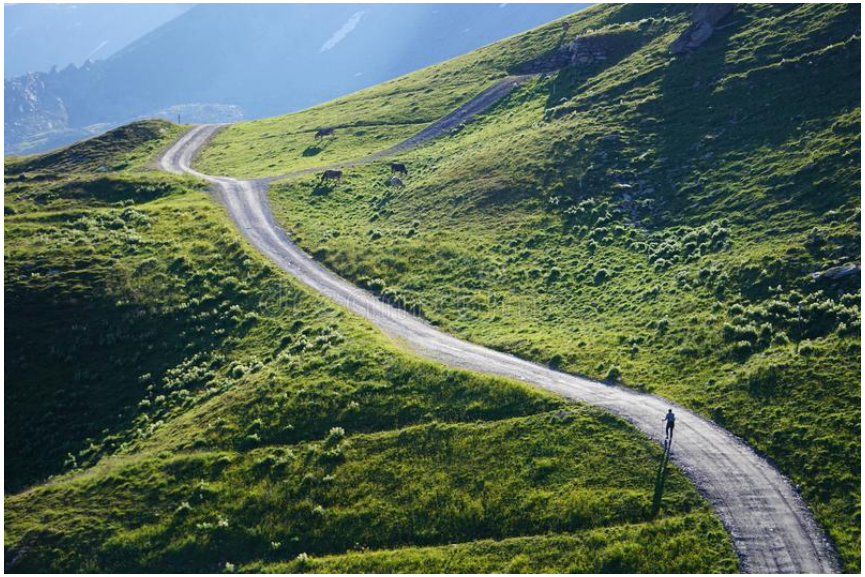

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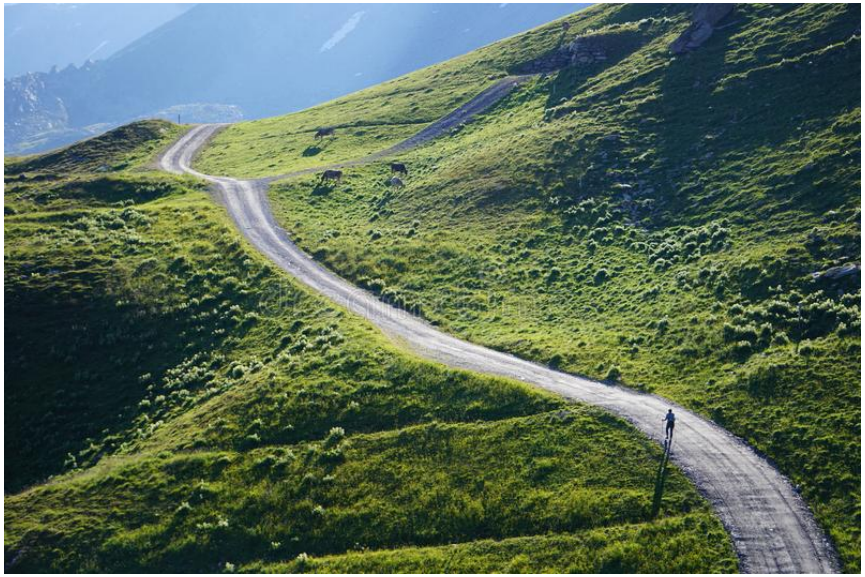
- Singularity for AI in the Law domain: the Semantic Web maturity



Trends in IT


Legal Semantic Web
Semantic Web
Linked Open Data
Web 4.0
Linked Open Data
Ontologies
eJustice
Ontologies
eJustice
Web 3.0
Web 3.0
Web 2.0
Open Data
Legal Semantic Web
eLaw
Smart Data
Web 2.0
Web 4.0
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Web 2.0
Web 4.0
Web 2.0
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Artificial Intelligence
Web 3.0
Linked Open Data

Pioneers

Lee Loevinger (Minnesota Supreme Court)

"Jurimetrics: The Next Step Forward", in: Minnesota Law Review 33 (1949)

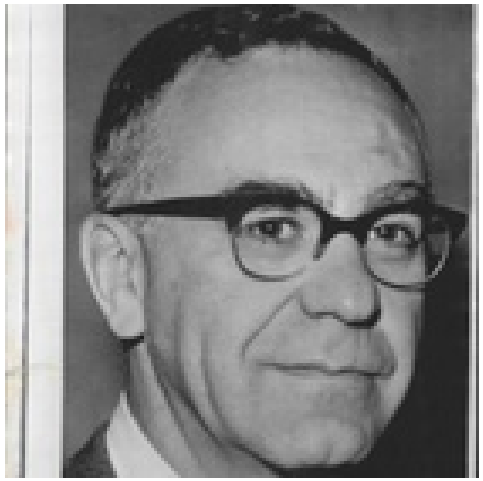
MINNESOTA
LAW REVIEW

Journal of the State Bar Association

VOLUME 33 APRIL, 1949 No. 5

JURIMETRICS
The Next Step Forward

LEE LOEVINGER*



A way to approach the Law inspired by computational methods

National Research Council of Italy (CNR), Florence

Int. Conference on "Logica, Informatica, Diritto"

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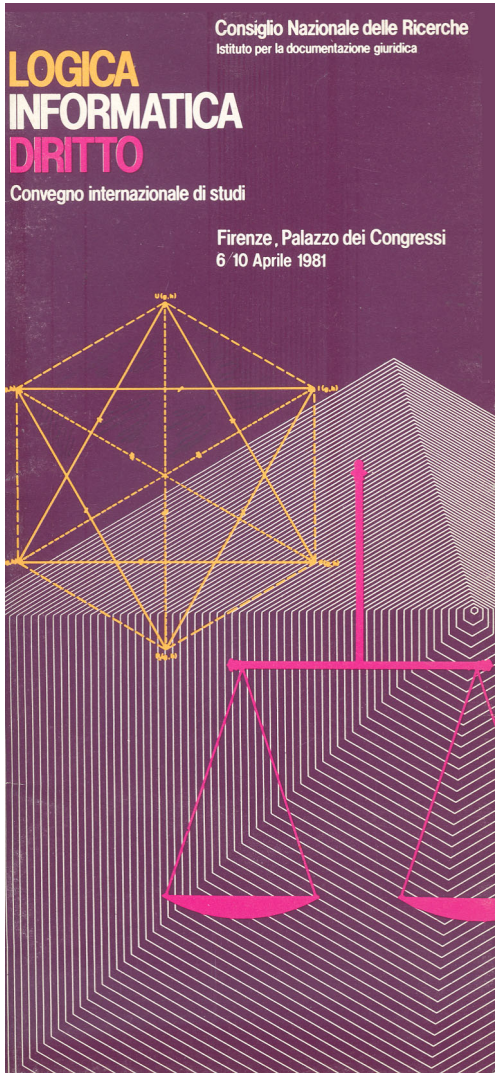
April 1981



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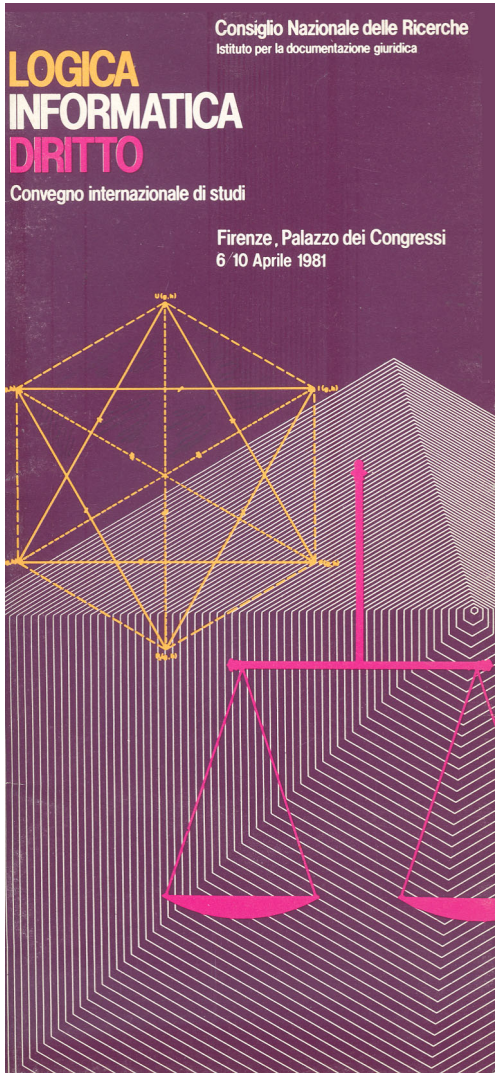
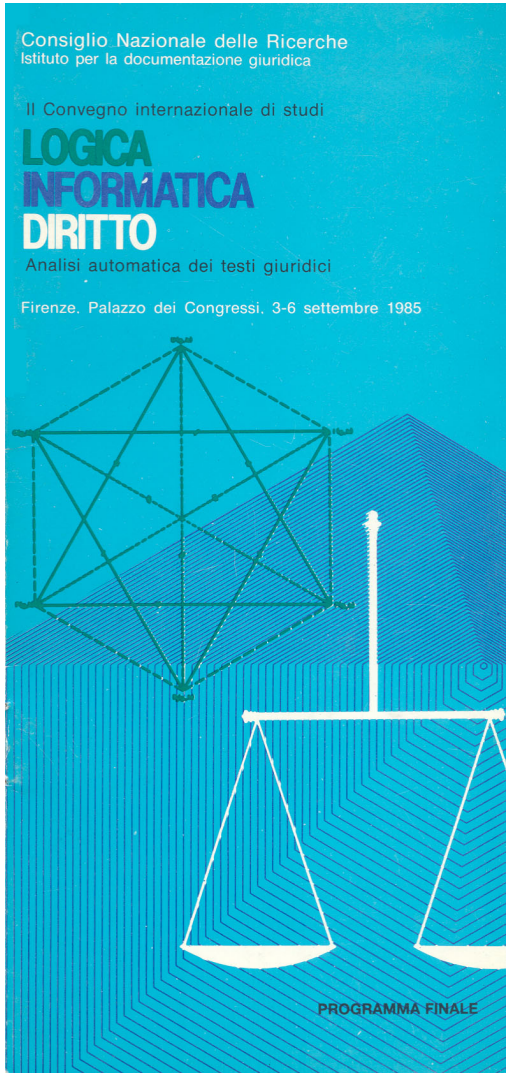


September 1985



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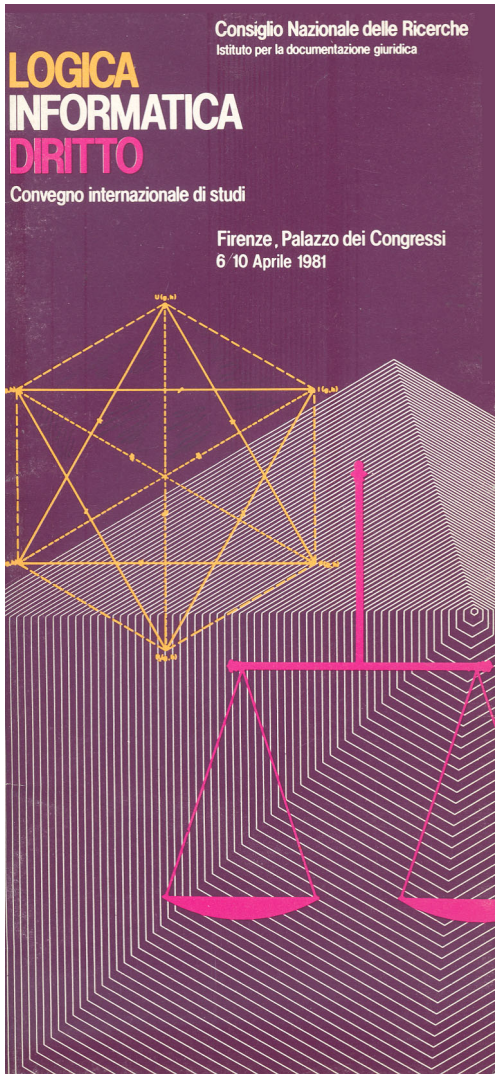

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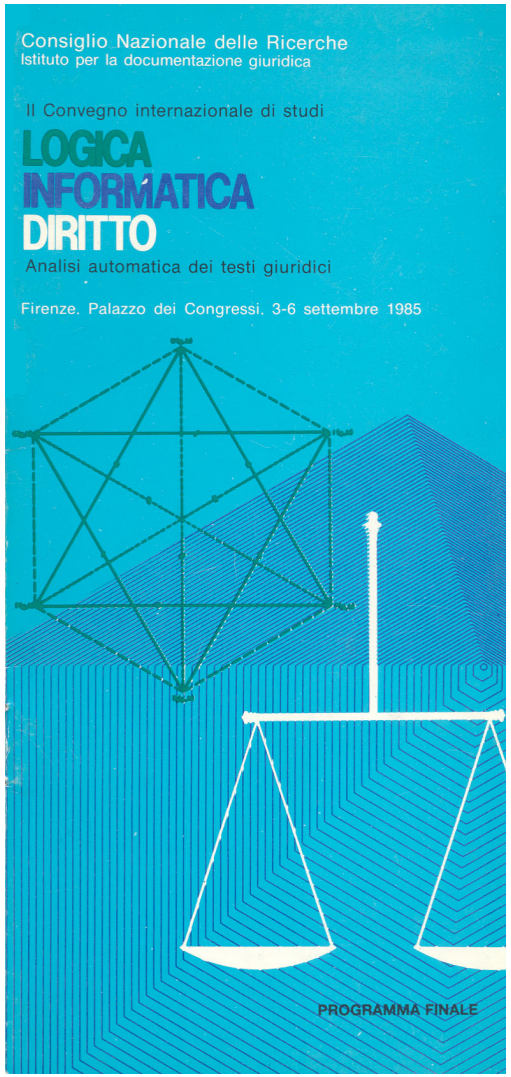
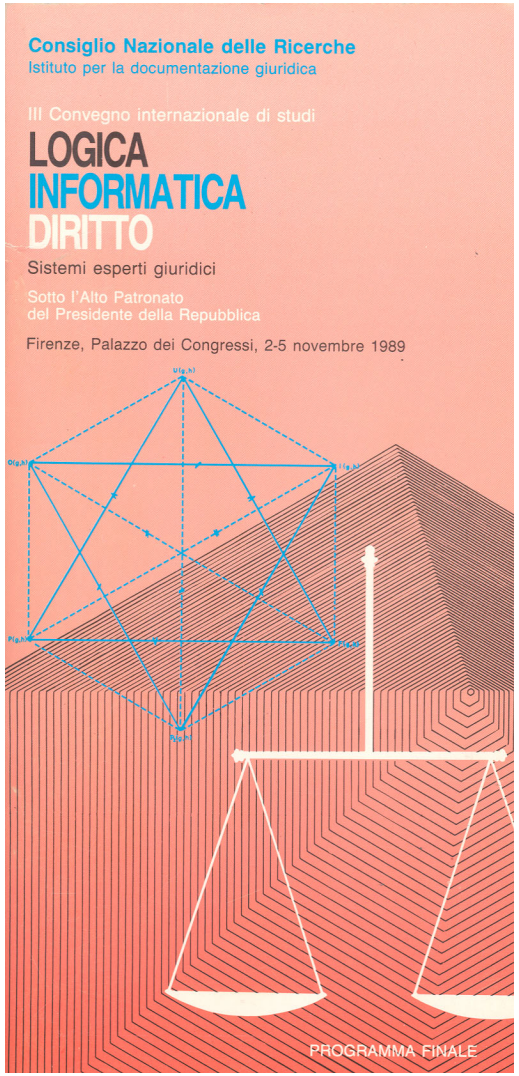


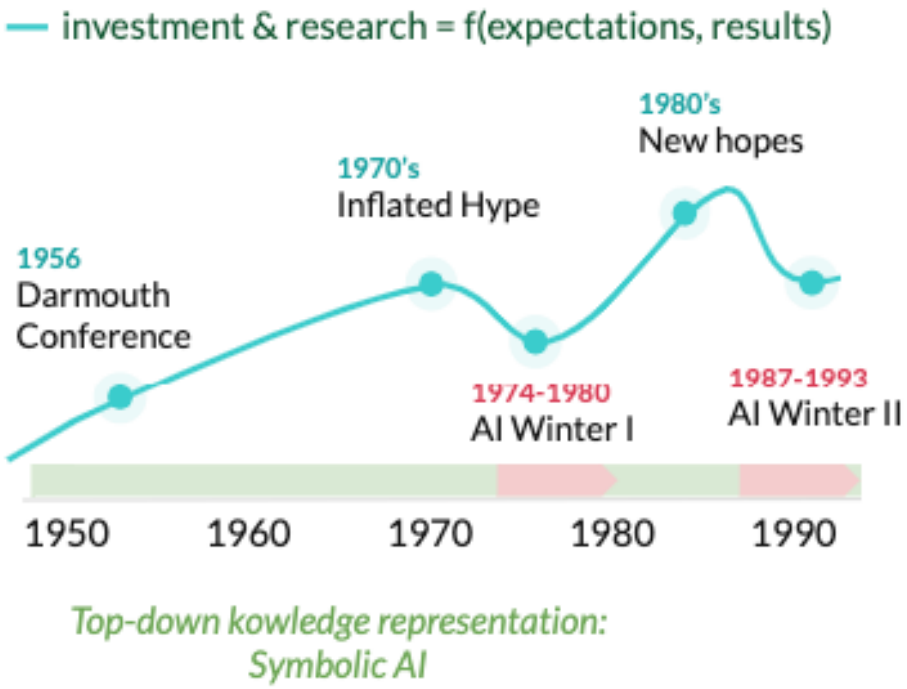
November 1989



IAAIL to support, develop and promote the field of AI and Law at the international level.

AI&Law pioneers and the AI-Winter

AI&Law pioneers developed their first studies (throughout the '80s) in the so-called *AI-Winter*



The AI Winter

AI in the '40-'90: from the early successes to the *AI Winter*

Limited results of symbolic AI

- toy applications
- cost and complexity to represent and upkeep rules and information (ex: Prolog)
- not every type of information is representable in symbolic form

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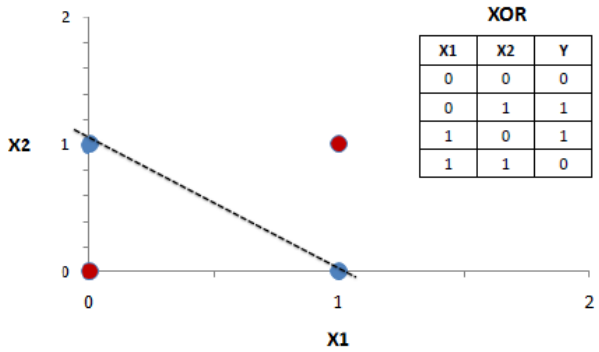
- *Perceptron algorithm* (Rosenblatt, 1958)
- *XOR problem* (Marvin Minsky and Seymour Papert, 1969)



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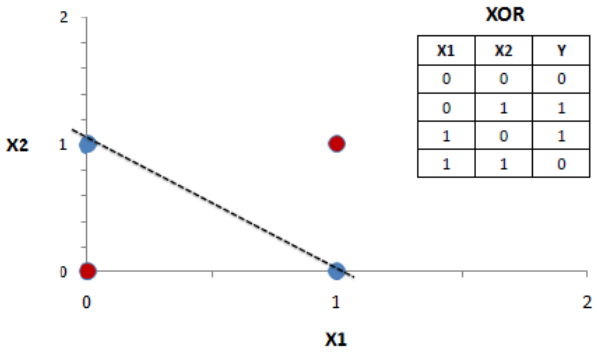
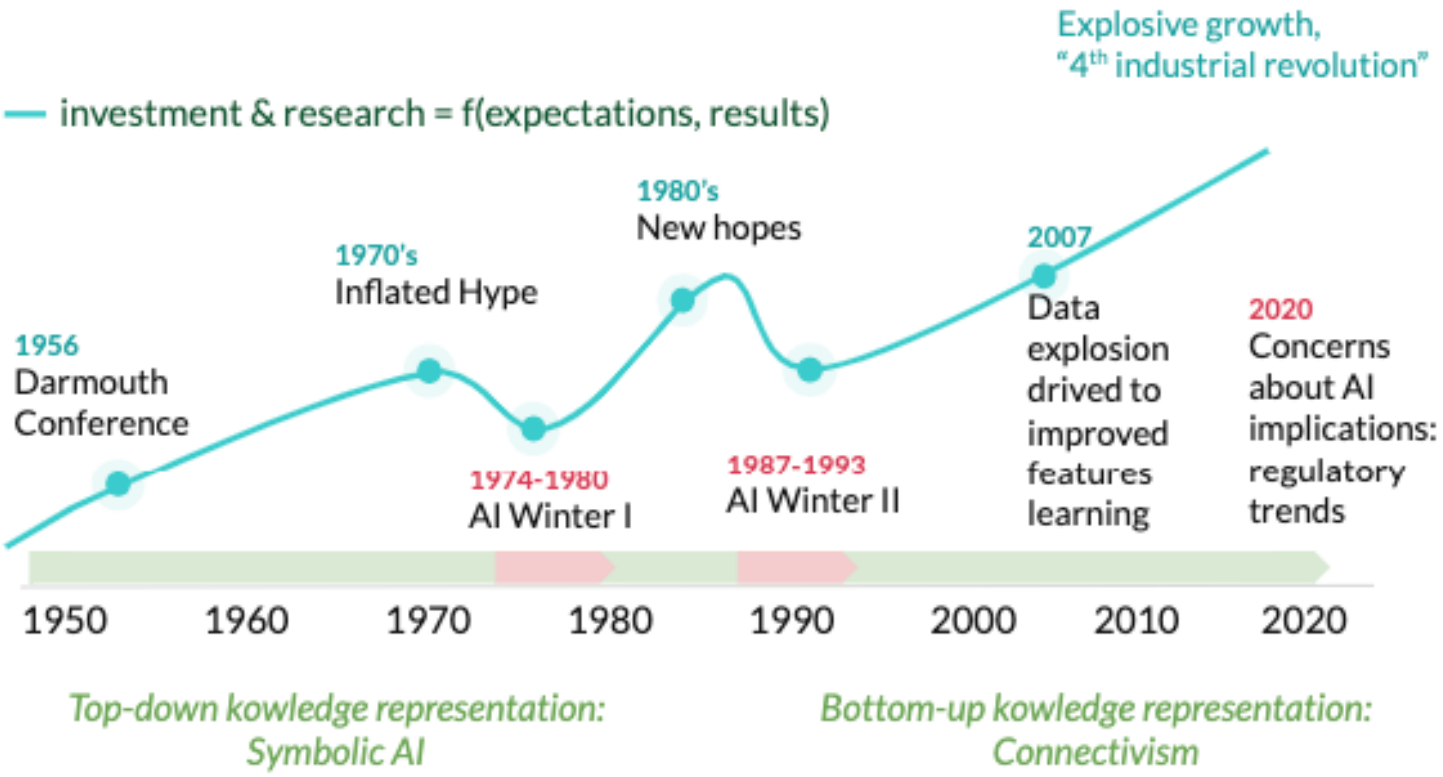
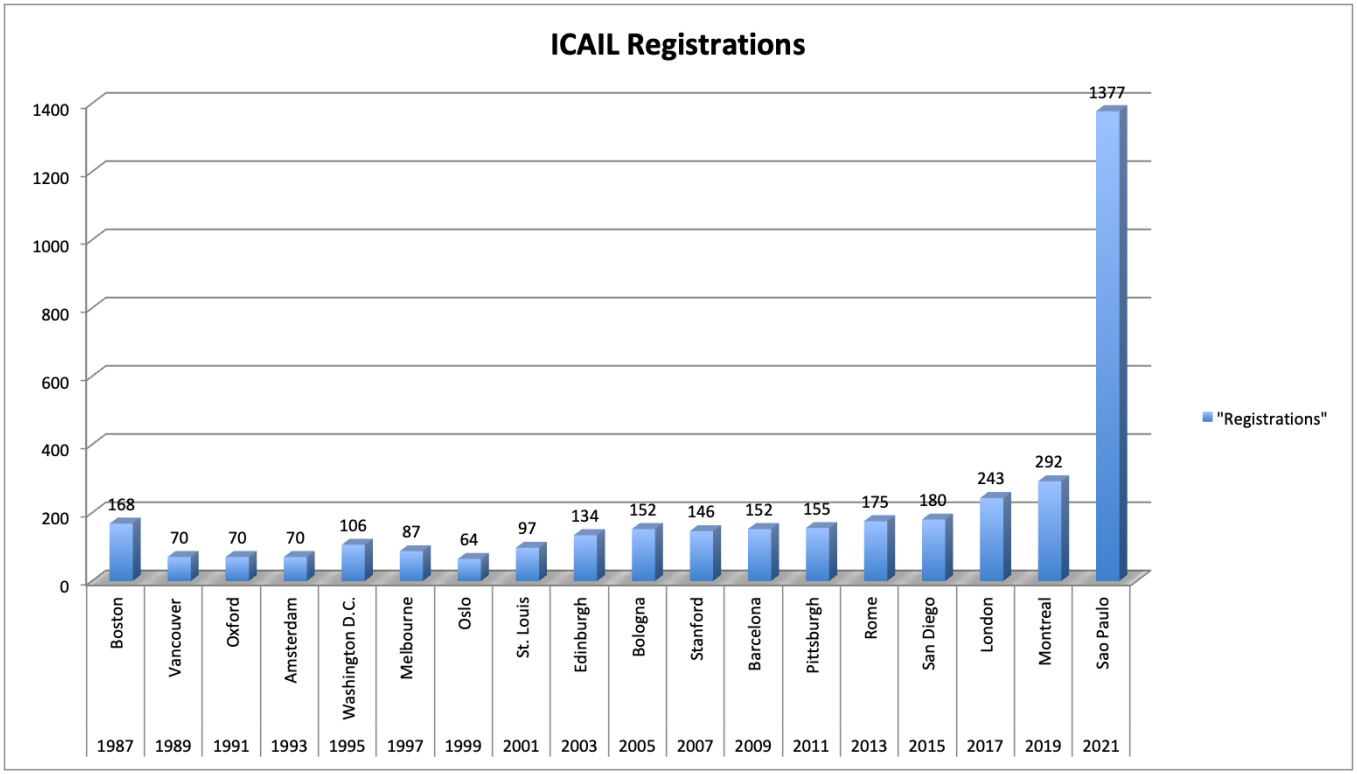


AI Winter: crisis in the AI research

Current hype for AI technologies



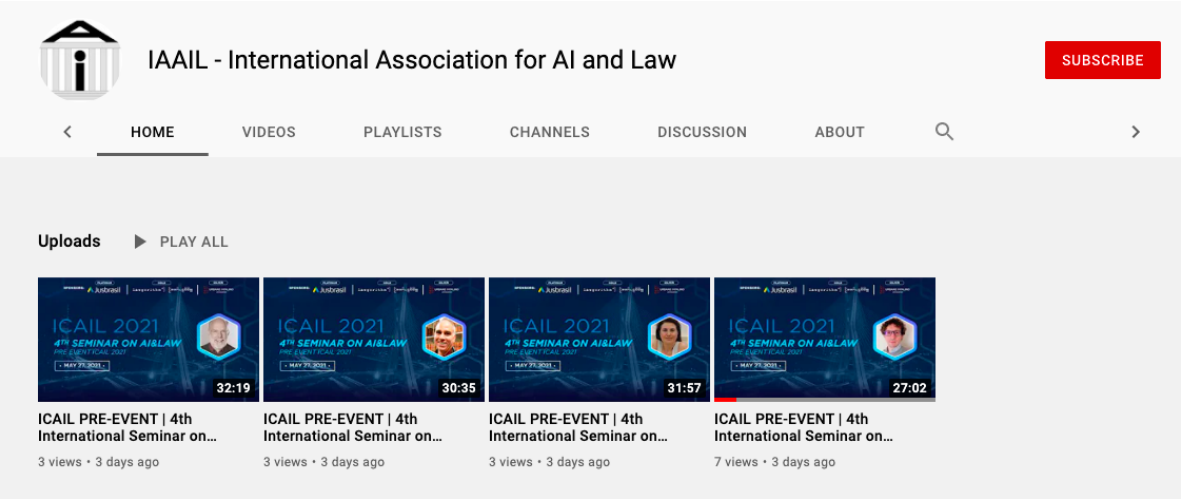
ICAIL overall registration trend



It testifies the good health of the ICAIL community

ICAIL 2021 in São Paulo, Brazil

- Hard decision to go completely on-line
- Local organisers have taken the risk, refocusing on the opportunities for the online version
- The challenge is won:
  - 500+ participants in the pre-event
  - ∼1400 registrations to the main conference
  - 89 paper submissions
  - 11 Workshops, 1 Doctoral Consortium
  - IAAIL Youtube channel: new opportunities of dissemination



The end of AI Winter

the trends in AI&Law and the current Hype

Approaches to AI&Law

Two distinct motivations

- Theoretical and Practical [McCarty, 1990]

- Theoretical motivation

  gain a better understanding of the process of legal reasoning and legal argumentation, using computational models and techniques

- Practical motivation

  build intelligent legal information systems supporting legal practitioners, decision makers and citizens

Early debate in AI&Law

Thorne McCarty

- *How much of legal reasoning can be reduced to reasoning with rules?*
- *How is it possible to reason with cases at all?*
- *Is it possible to develop a computational theory of legal arguments?*

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Need of a "deep conceptual model"

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"A language for legal discourse" (ICAIL 1989)

Early debate in AI&Law

Trevor Bench Capon

- *Intelligent legal information systems for most practical applications can be built without "deep conceptual models"*
- *Expert system based on a formalisation of the legislation, and a faithful representation of the legal rules*

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Isomorphism

T. Bench-Capon, "Deep models, normative reasoning and legal expert systems", (ICAIL 1989)
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T. Bench-Capon, "Neural networks and open texture", (ICAIL 1993)

Early debate in AI&Law

Complementary positions

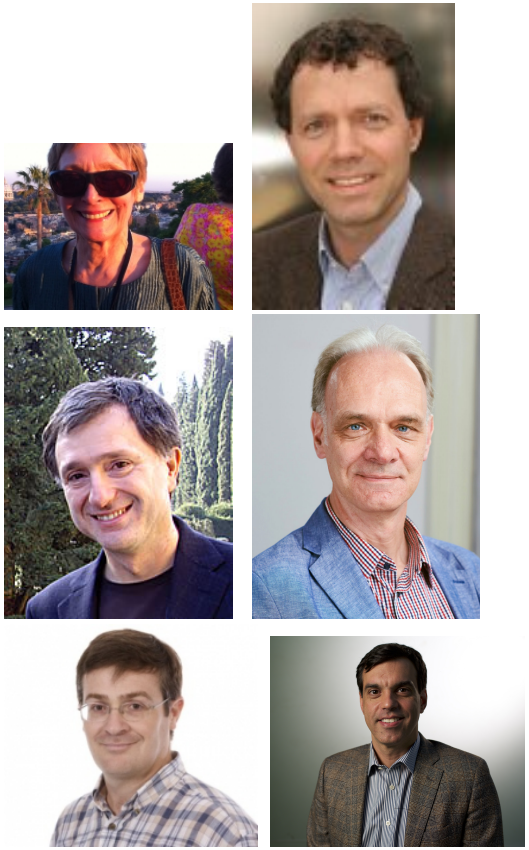
Top-Down Approach

$\Updownarrow$

Bottom-up Approach

to AI&Law

Legal Reasoning



- Legal reasoning based on "open-textured" concepts
- Non-monotonic reasoning
- Rule-based approaches to defeasible reasoning
- Preferences over rules in non-monotonic reasoning
- Models for adversarial legal reasoning
- Deontic logic

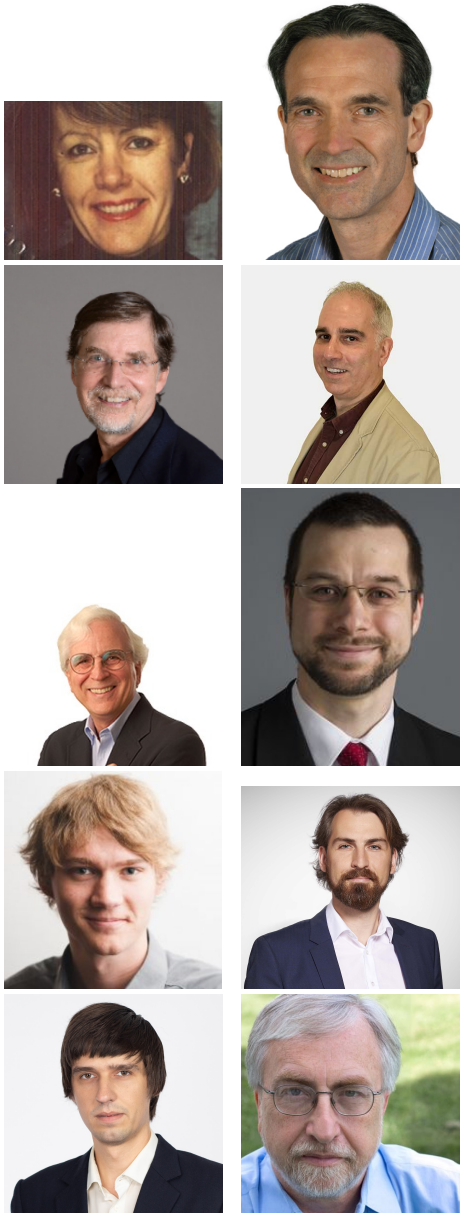
Argumentation, Rules and Cases

- General Theory of Argumentation
- Dialogues between parties
- Analysis of rules and precedents
- Persuasion and Values in Legal Arguments
- Argumentation schemes
- Arguments and Stories

Legal Reasoning, Ethics and Explainable AI

- Case-based reasoning and factors (CATO)
- Deontic logic
- Responsible AI
- Evidential reasoning and bayesian networks

Data Systems



- Connectionist Models applied to the legal domain
- Legal Information Retrieval and eDiscovery
- Argument Extraction
- Legal Predictions
- Legal Text Summarization
- Legal Network Analysis
- Quantitative reasoning

Bridging the gap between "case-based" and "rule-based" legal reasoning

- Reasoning with cases and hypotheticals in HYPO
- notions of relevant similarities and differences between cases and analogous precedents
- roles of precedents in legal arguments and hypotheticals
- rules and cases to solve case-based reasoning problems (CABARET)

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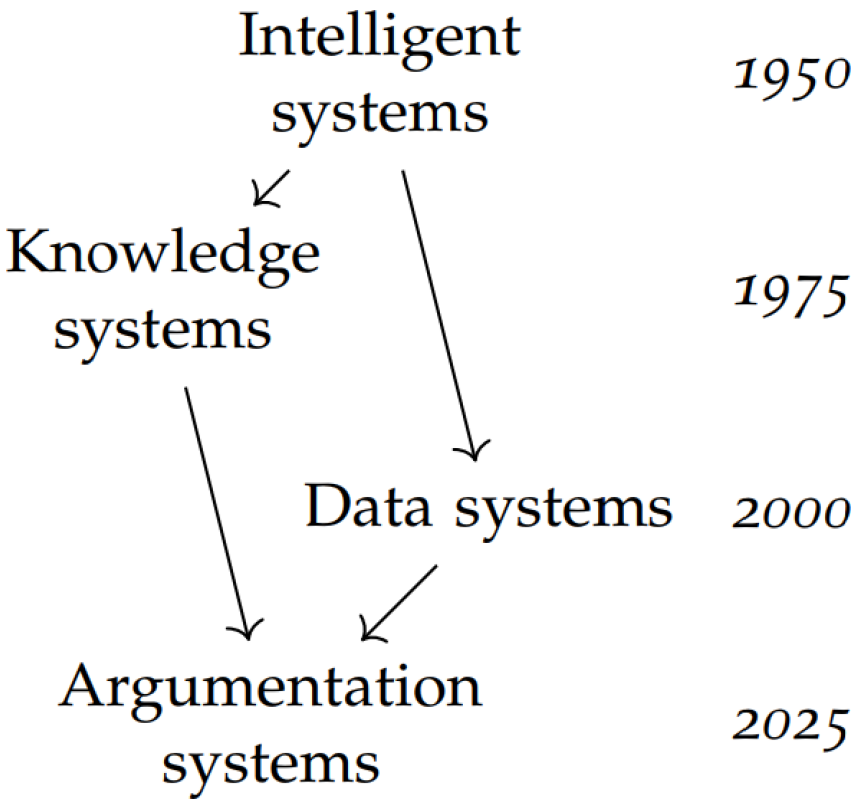
- Building explanations from rules and structured cases

Bridging the gap between knowledge and data systems in AI



AI as Law

Hybrid systems connecting knowledge representation and reasoning techniques with machine learning

Bart Verheij (Presidential Address ICAIL 2019)

Lesson learned from the AI & Law debate

Lots of theoretical achievements

- Symbolic models
- Sub-symbolic (connectionist) models

Lesson learned from the AI & Law debate

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Limited number of large scale applications

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AI and Knowledge

AI and Knowledge

Elaine Rich (Univ. Texas), Kevin Knight (Univ. South. California)

Intelligence requires Knowledge

AI and Knowledge

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Intelligence requires Knowledge

AI Winter mainly due to insufficient amount of Knowledge

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Intelligence requires Knowledge

AI Winter mainly due to insufficient amount of Knowledge

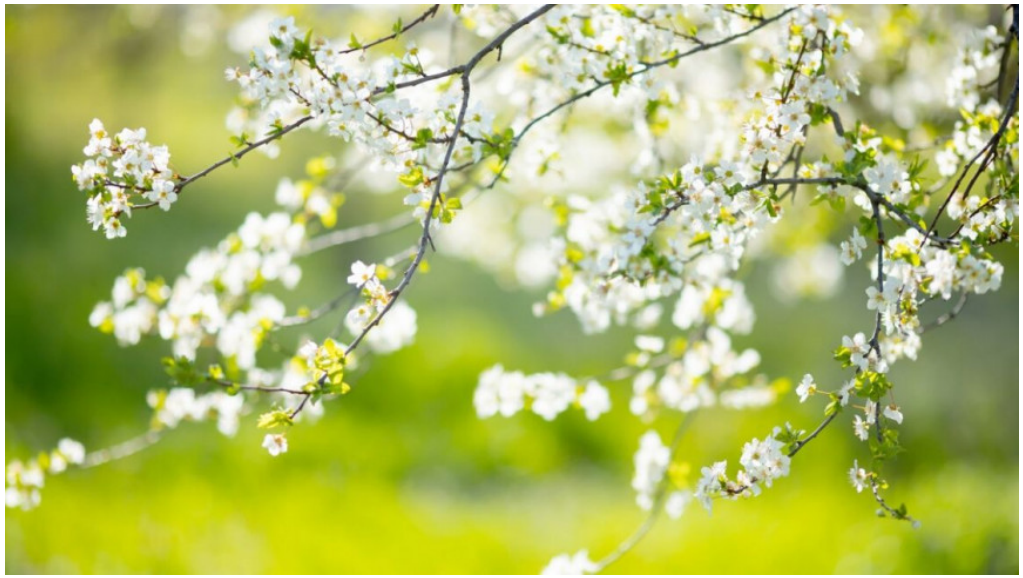
Problems in managing Knowledge

- It's voluminous
- It's hard to characterise accurately
- It is constantly changing
- It differs from data because it needs a semantic organization

In early '90 AI meets the Web this changes everything!

AI and the Web: the end of the *AI Winter*

- **Web as source of Knowledge for AI**
  Availability of huge quantity of information in digital format for the development of AI systems



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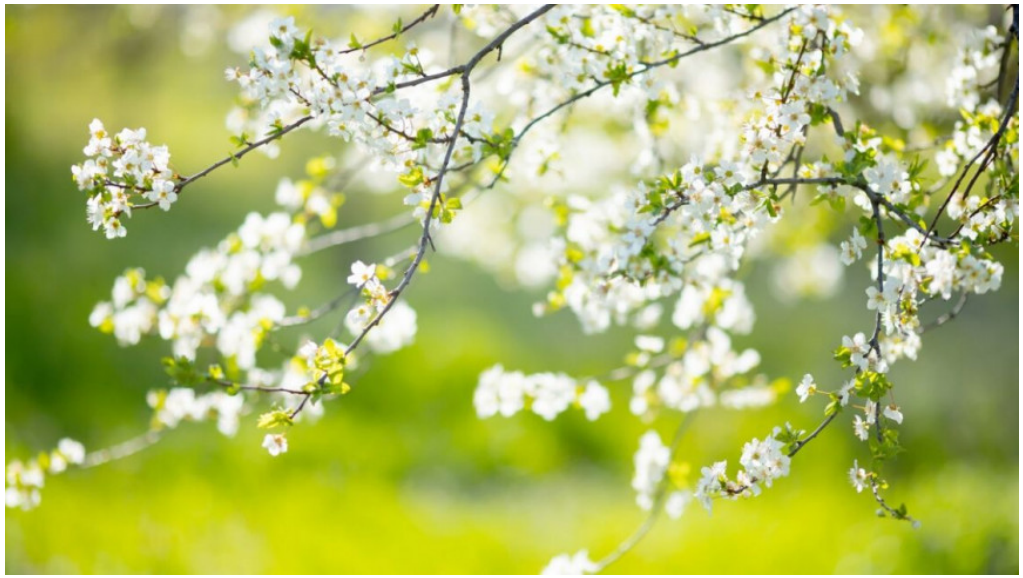
  Internet and the Web need advanced AI applications for managing data



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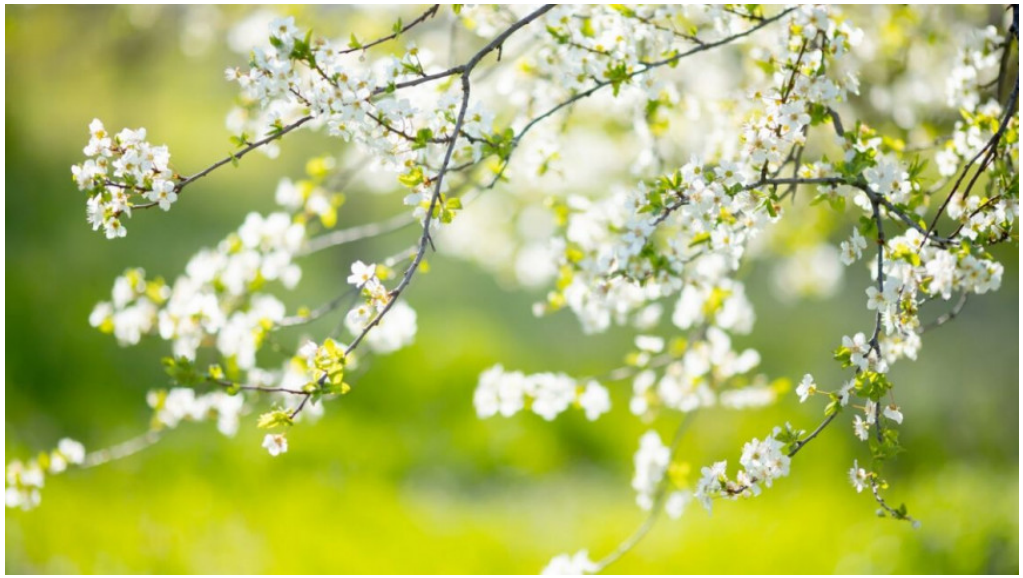
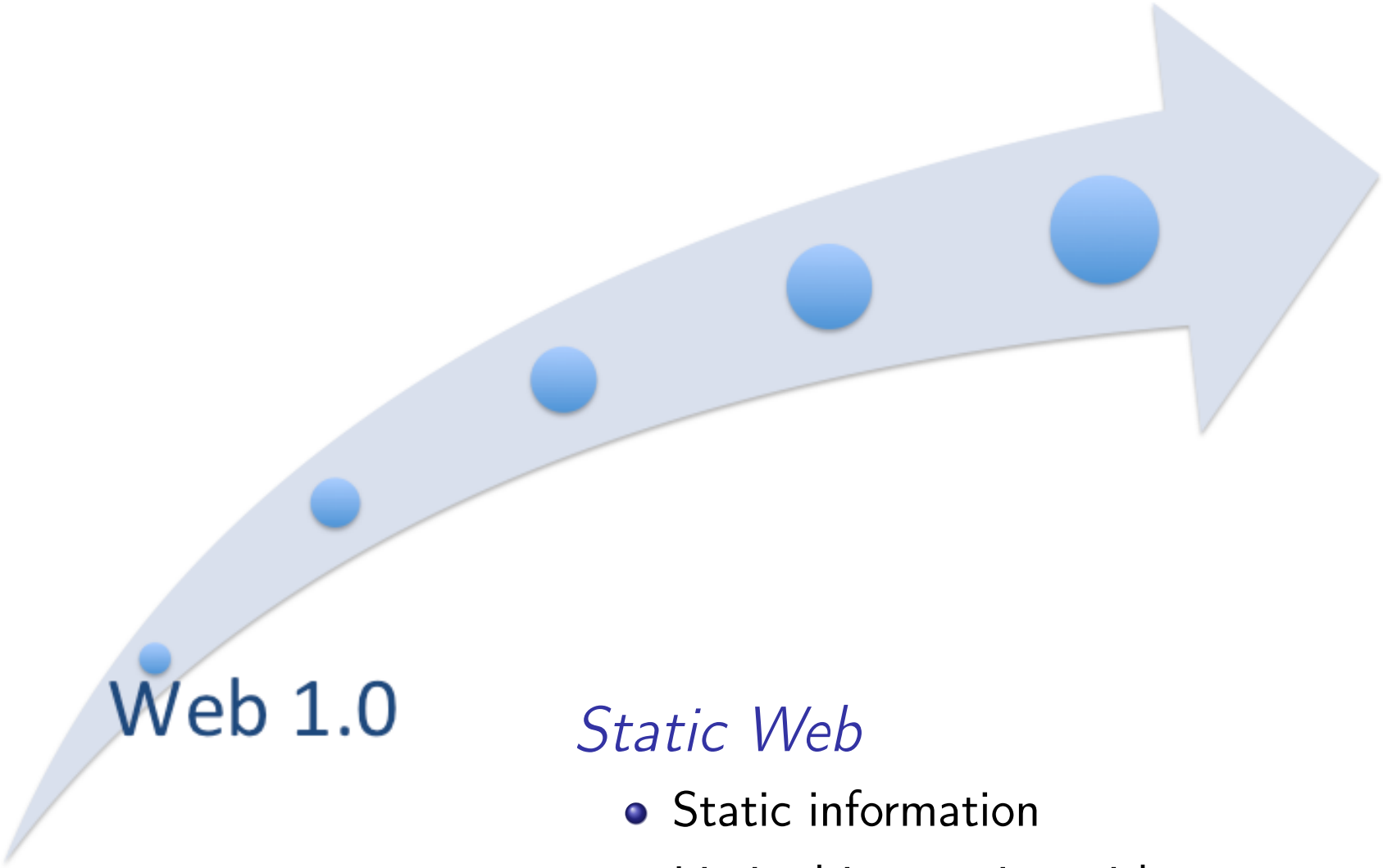


The AI evolution has followed the Web evolution

From Web 1.0 to Web 3.0

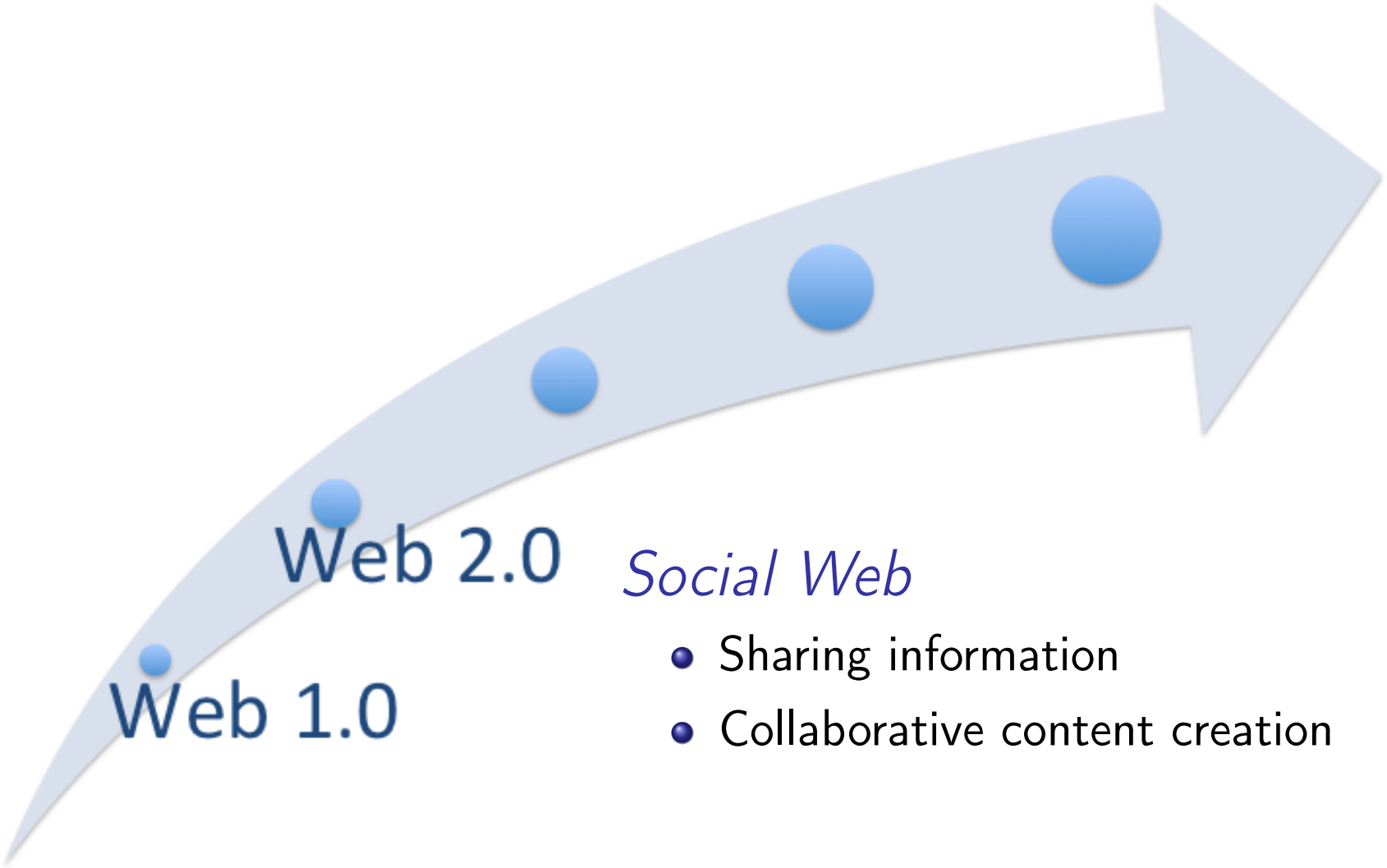
Web evolution



Static Web

- Static information
- Limited interaction with users

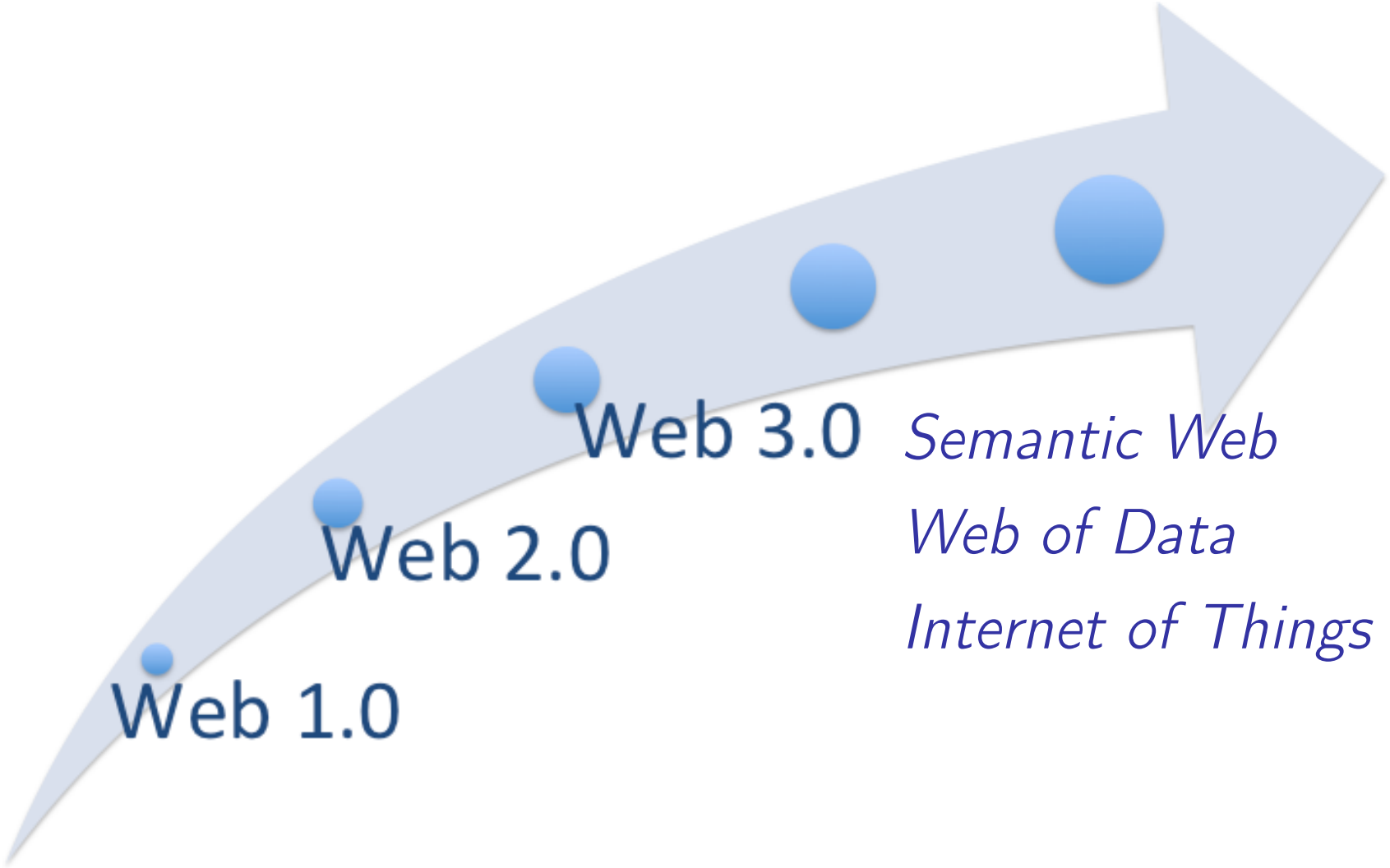
Web evolution



Social Web

- Sharing information
- Collaborative content creation

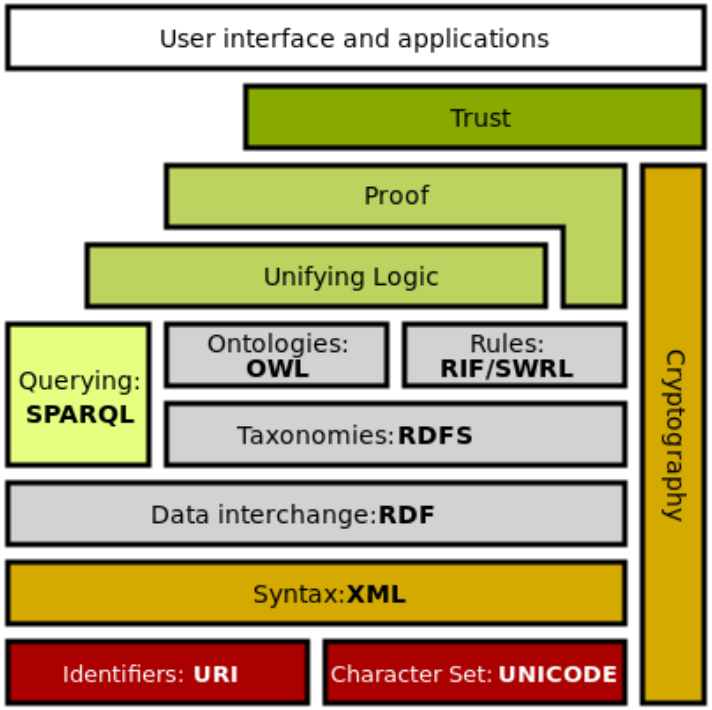
Web evolution



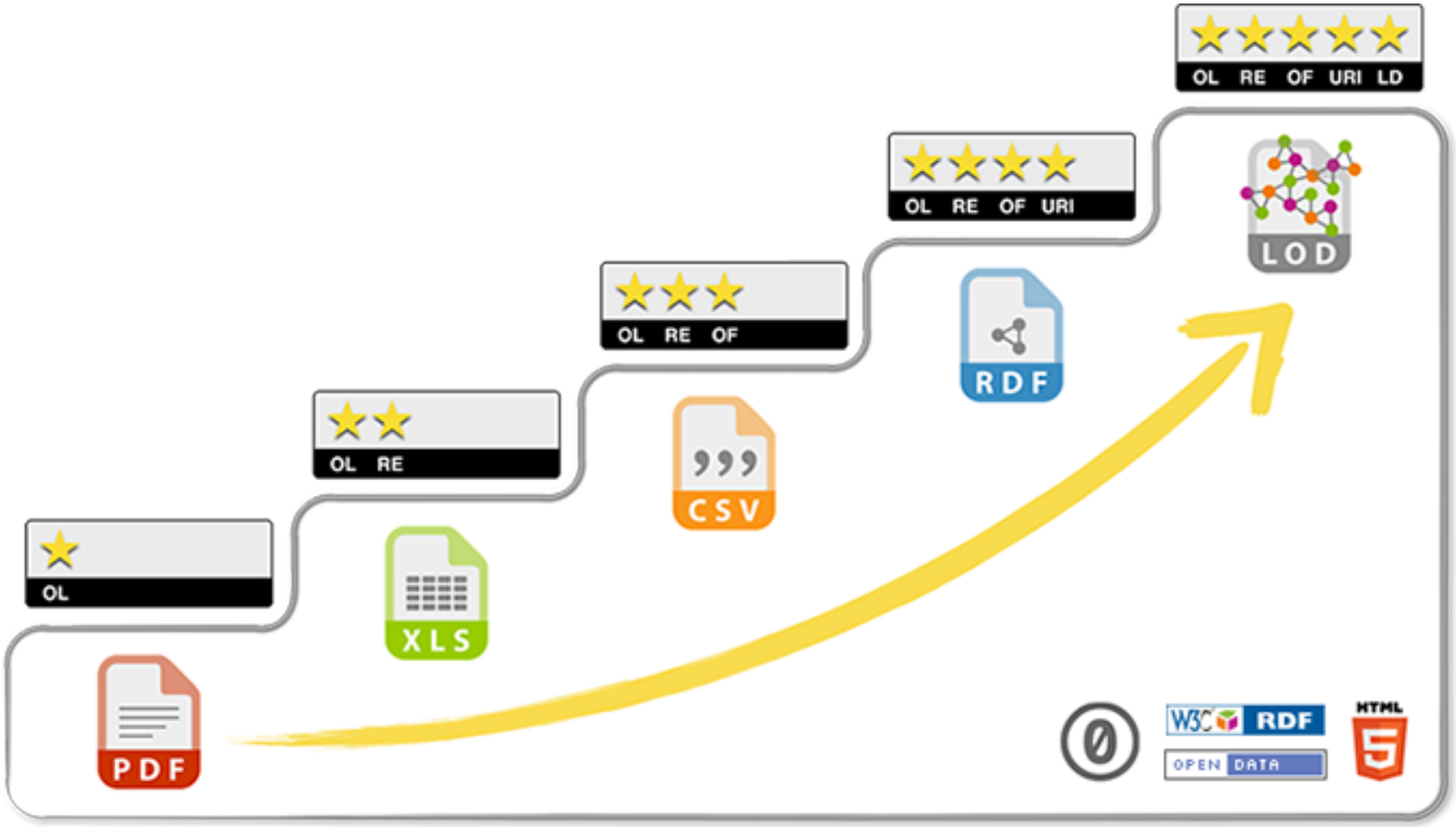
Semantic Web

Objectives

- Technological and semantic interoperability between information systems
- Advanced information services

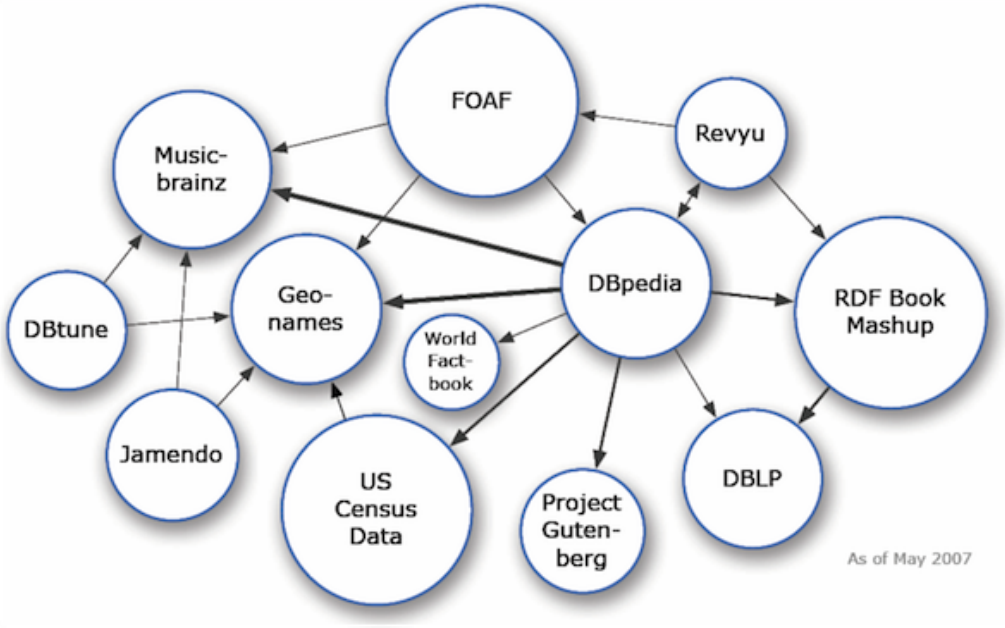


5-star Rating Scheme for Linked Open Data

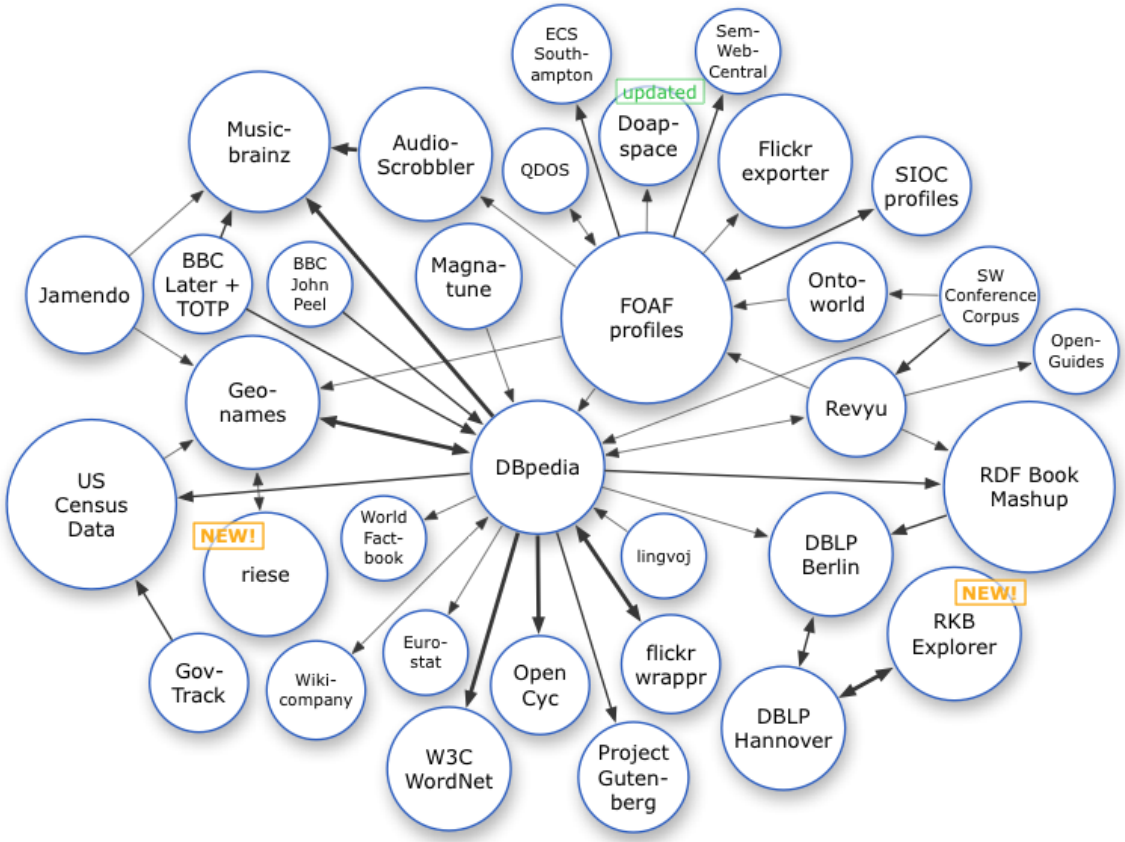


Tim Berners-Lee. "Linked Data – Design Issues", 2006.

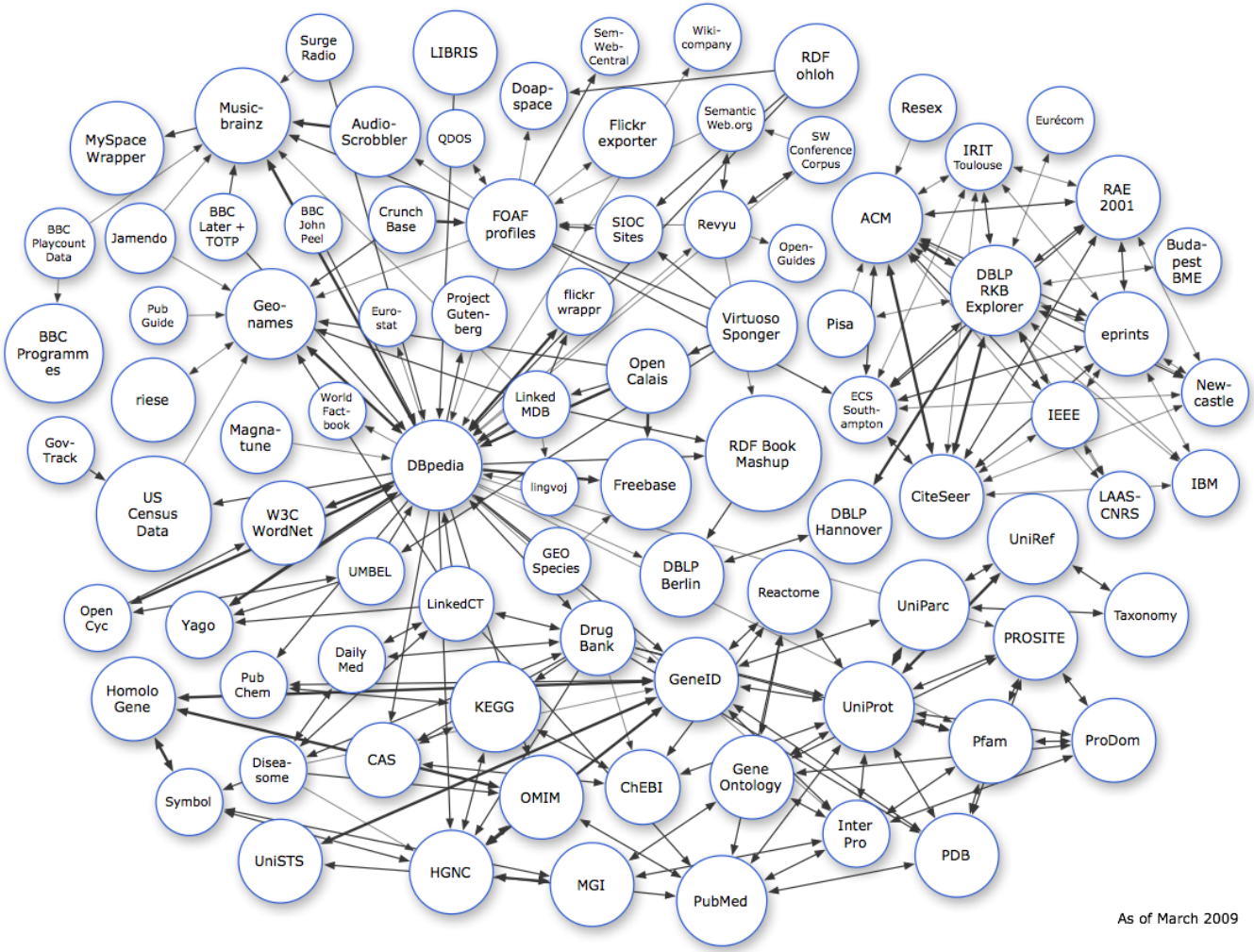
Linked Open Data growth (2007)



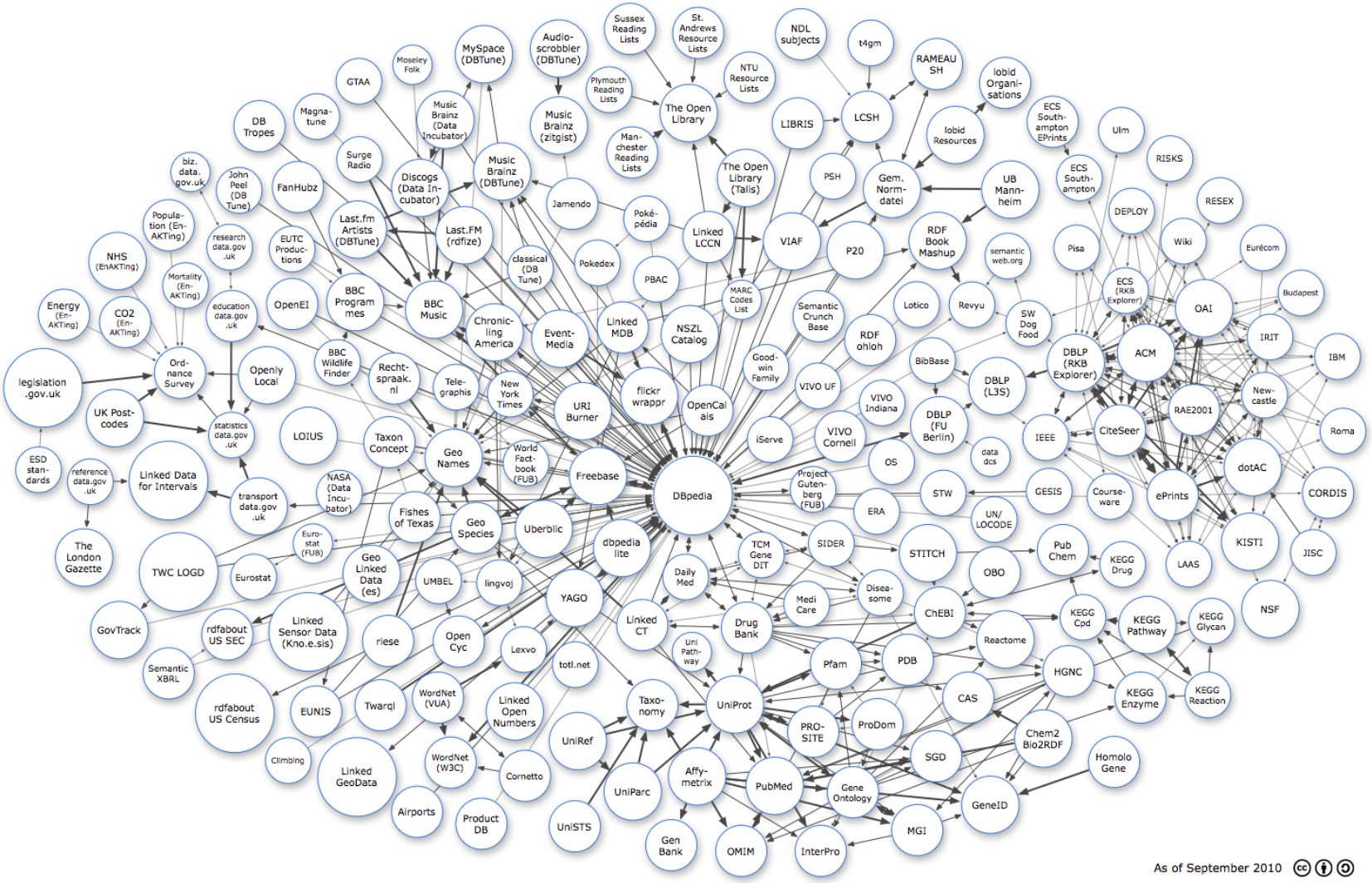
Linked Open Data growth (2008)



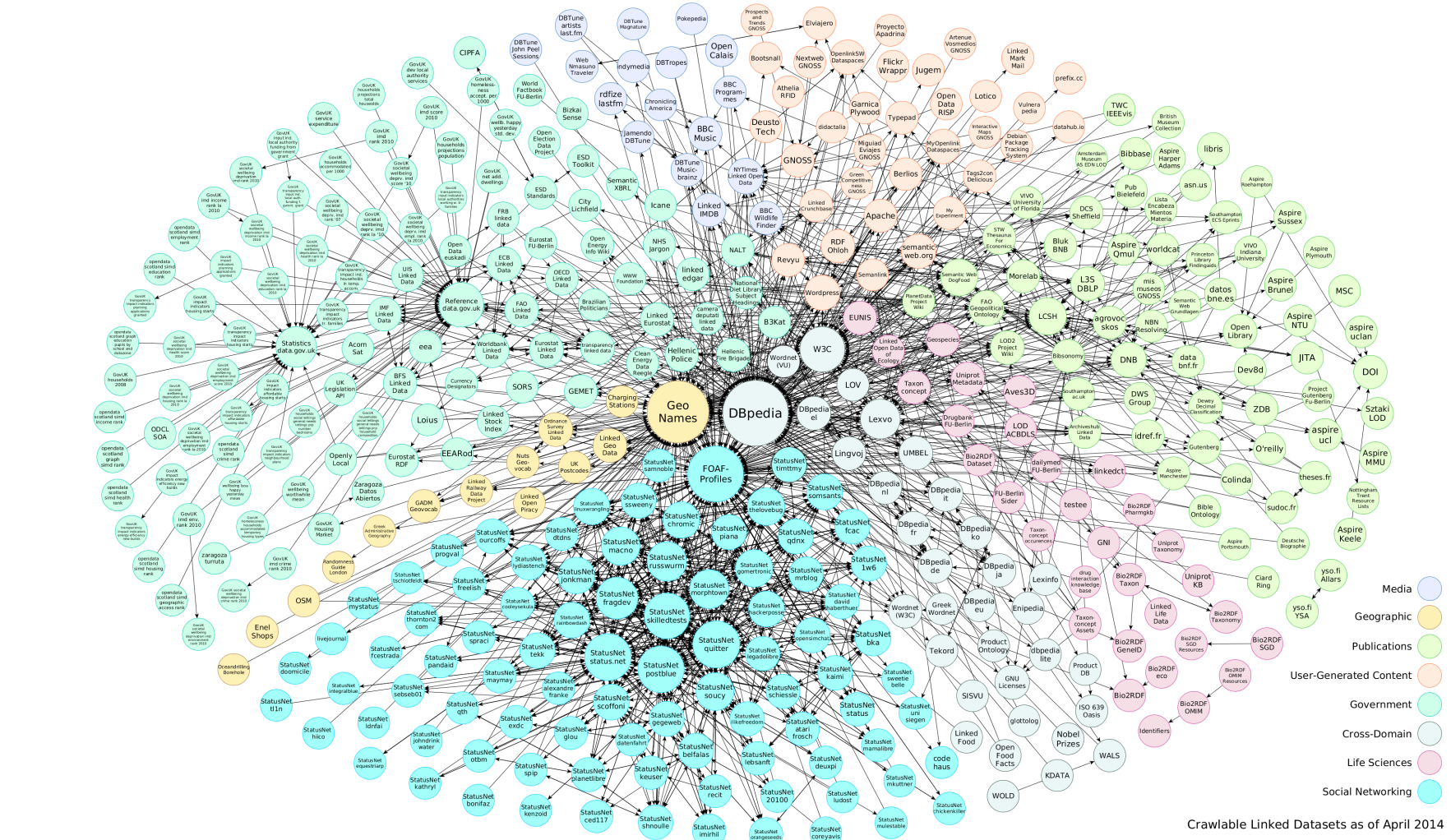
Linked Open Data growth (2009)



Linked Open Data growth (2010)



Linked Open Data growth (2014)



"Intelligence requires Knowledge"

Knowledge is Data and Semantics

Knowledge is Data and Semantics

Knowledge is on the Web

Knowledge is Data and Semantics

Knowledge is on the Web

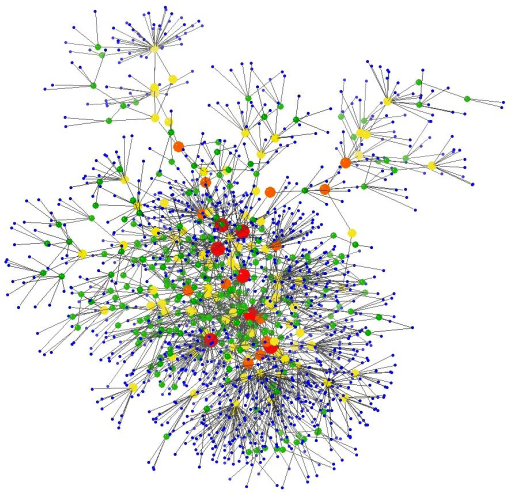
Knowledge is on the Semantic Web

Semantics

Data

Semantics

- Top-down approach to AI&Law
  - legal knowledge representation
  - reasoning and argumentation
  - planning and explainability



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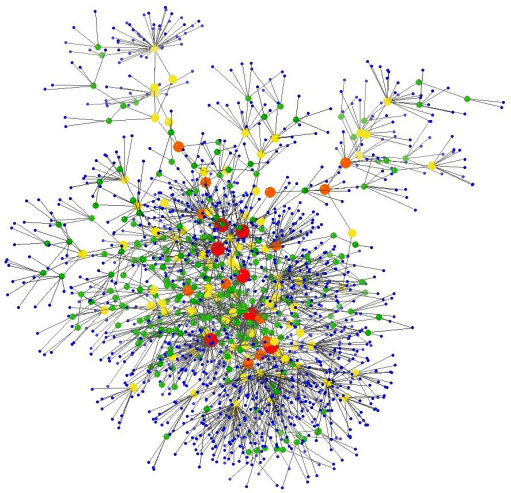
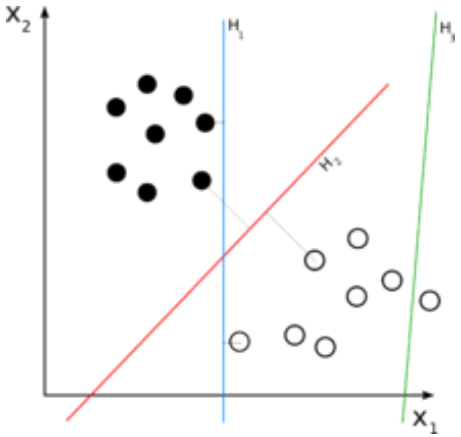


Data

- Bottom-up approach to AI&Law
  - Machine/Deep Learning and NLP for rule-based or case-based systems
  - argument mining
  - legal information discovery and retrieval



In the Summer of AI&Law

Semantic Web infrastructure for *AI*

- It provides Languages for Knowledge representation
- It provides Smart Data for intelligent systems

Lesson learned from AI&Law debate

Need for

- Knowledge Models
- Languages for knowledge representation
- Rules description and activation
- Logic and Algorithms for legal reasoning
- Data and Smart Data

Lesson learned from AI&Law debate

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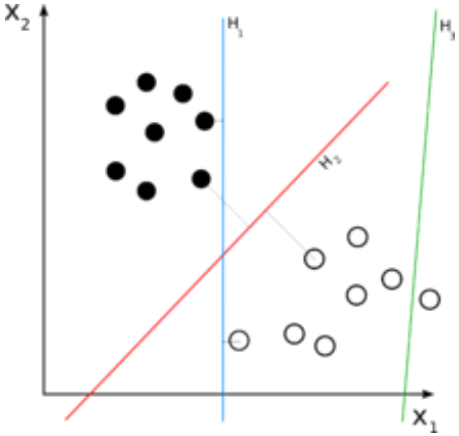
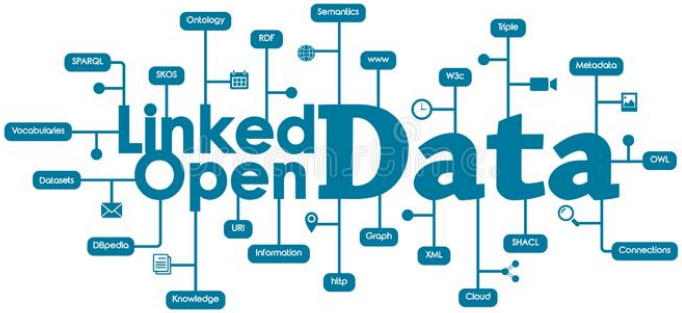
This is what the Semantic Web does!

Semantic Web infrastructure for *AI in Law*

- It provides languages for legal knowledge representation
- It provides Smart Data for legal autonomous agents to mimic intelligent behaviour

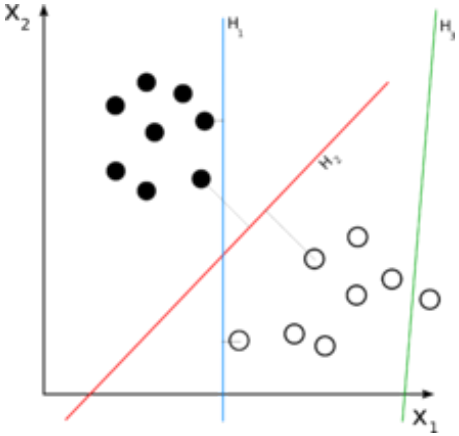
Role of the Semantic Web for AI in Law

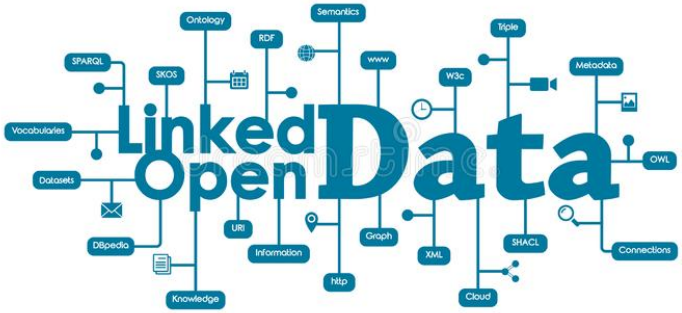


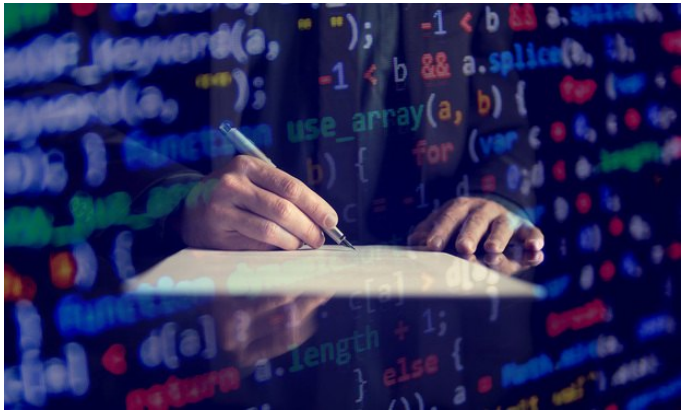


Role of the Semantic Web for AI in Law

Semantic Web



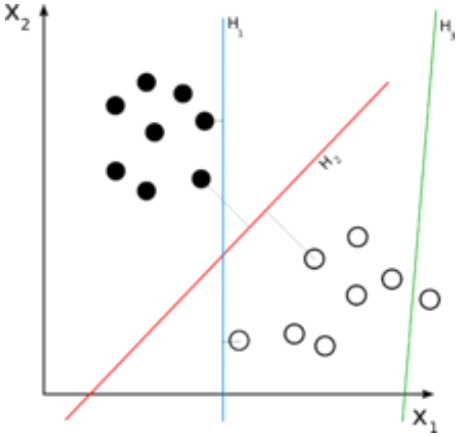


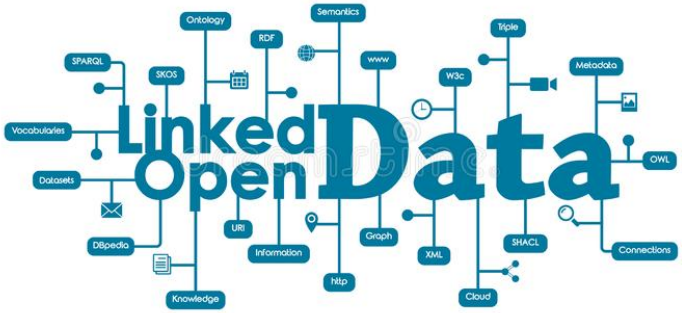


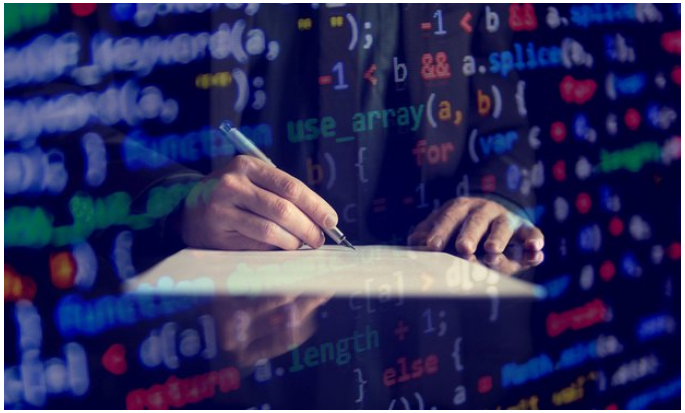
Law as Code

Role of the Semantic Web for AI in Law

Semantic Web



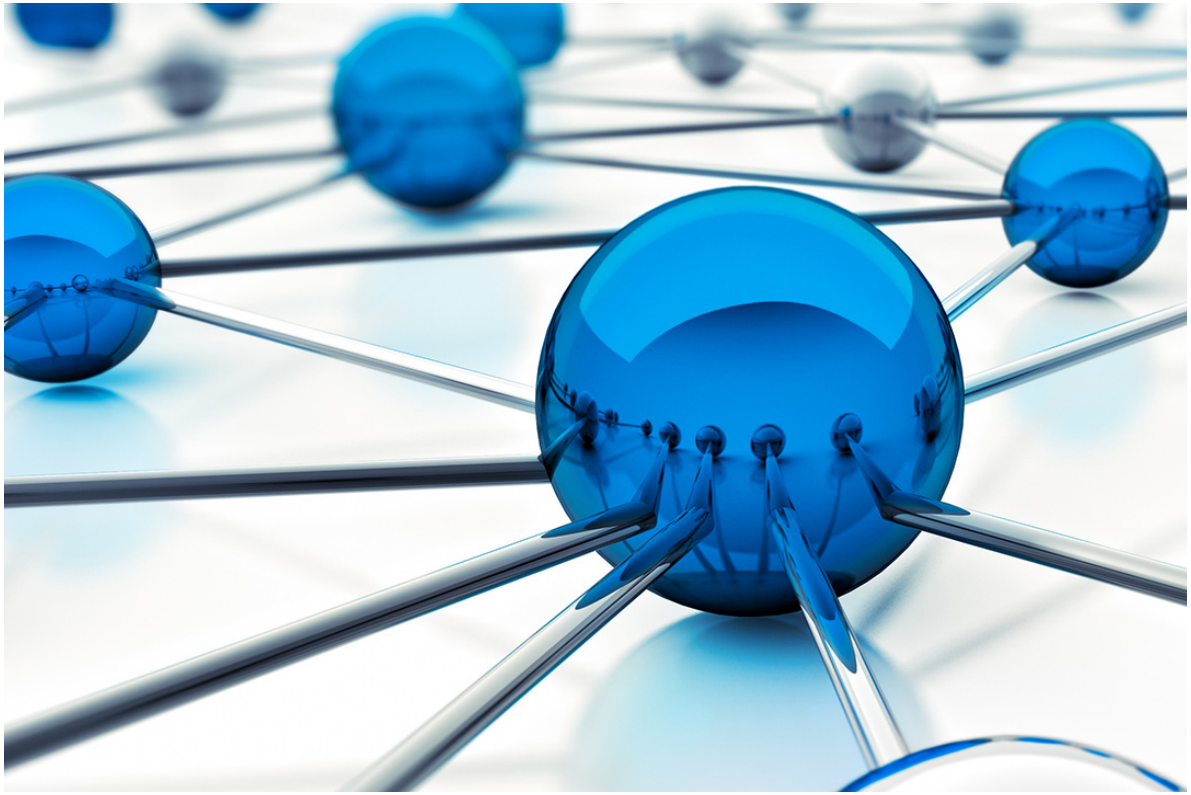




Law as Code

Smart Data $\Longrightarrow$ AI&Law applications in large scale

The Semantic Web for AI&Law



Semantic Web Approaches for AI&Law

Semantic Web Approaches for AI&Law

- K. Ashley, "The Case-Based Reasoning Approach: Ontologies for Analogical Legal Argument" in Approaches to Legal Ontologies (2011)
  - Support case-based comparisons between problems and cases
  - Distinguish deep and shallow analogies
  - Induce/test hypotheses (hypothetical reasoning).

Scenario of my Research

Legal Rules, Provisions and Norms

Legal Rules described at 2 different levels of abstraction

Provisions

A set of signs organized in words and sentences for creating normative statements

Norms

The meaning (application) of such normative statements

Legal Rules, Provisions and Norms

Legal Rules described at 2 different levels of abstraction

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A set of signs organized in words and sentences for creating normative statements

- Textual objects

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The meaning (application) of such normative statements

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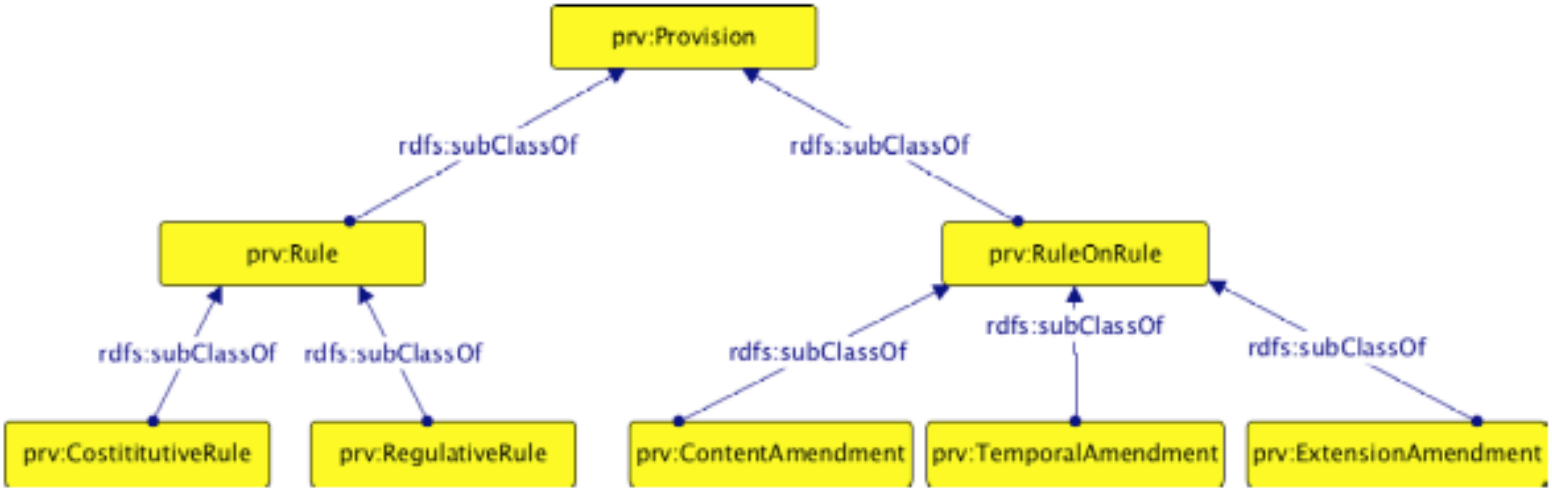
Scenario of my Research



Provision Model (OWL/RDF(S))

Scenario of my Research

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Legal Drafting (XML)
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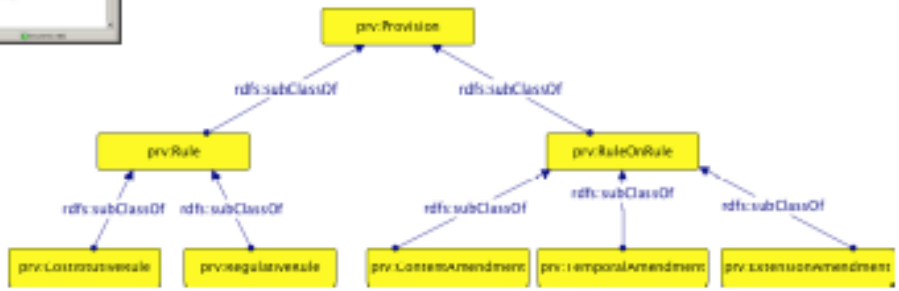
- Regulative Impact Analysis



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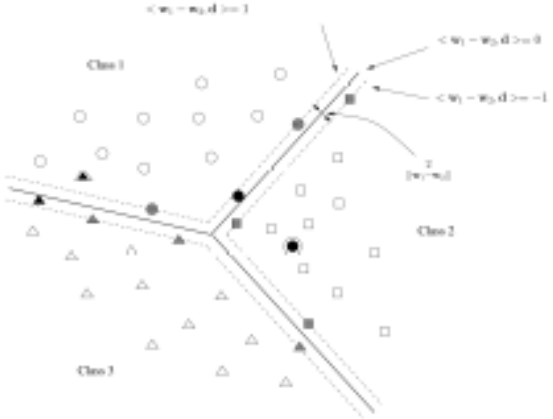
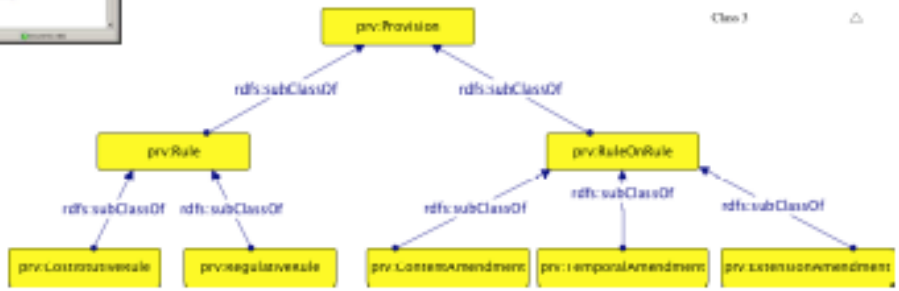
Semantic Annotation of Provisions by ML and NLP





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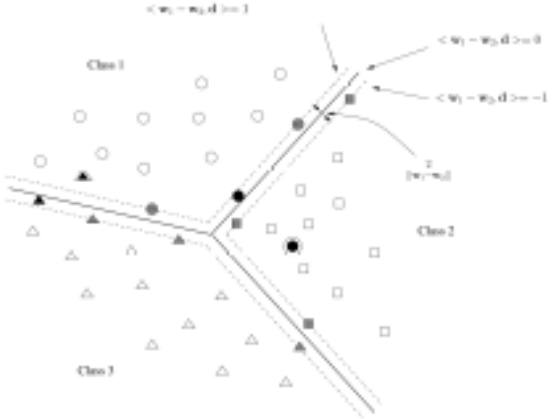

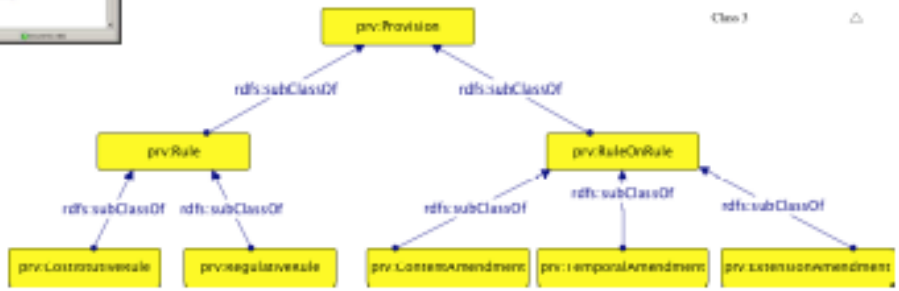

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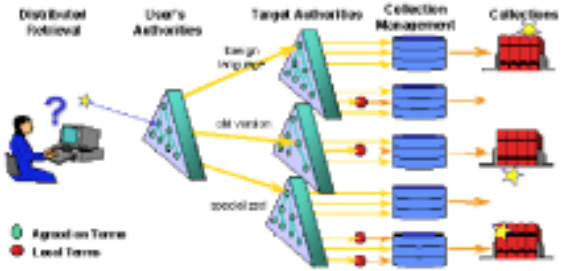

Legal Information Retrieval Hohfeldian reasoning (OWL-DL)

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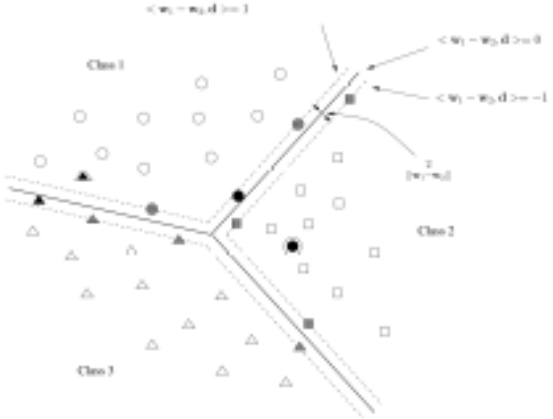
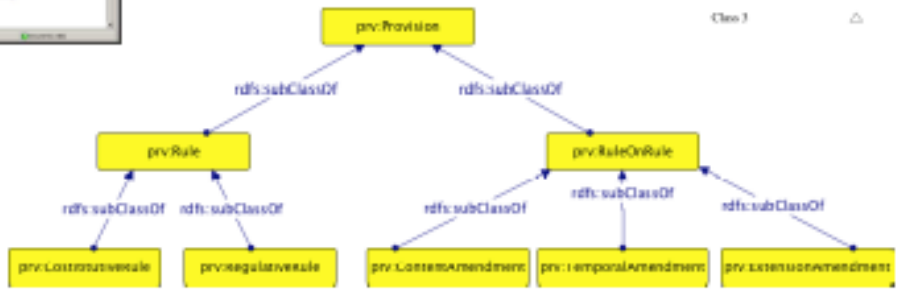
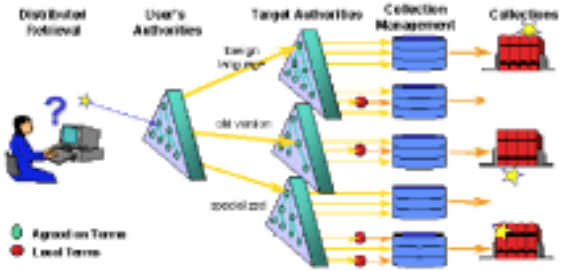




Provision Model (OWL/RDF(S))

Norms modeling for Legal Compliance Checking (OWL-DL)



Legal Information Retrieval Hohfeldian reasoning (OWL-DL)

Legal Knowledge Modeling

Research question

To identify sufficient conditions for implementing legal reasoning within a DL framework (DL-Rules e DL-safe Rules)

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Some problems that can be addressed

- Standard/Temporal Deontic Logic
- Non-monotonic/defeasible reasoning
- Argumentation schemes
- Legal reasoning

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Use of available reasoners within a *decidable* computational framework

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Hypothesis

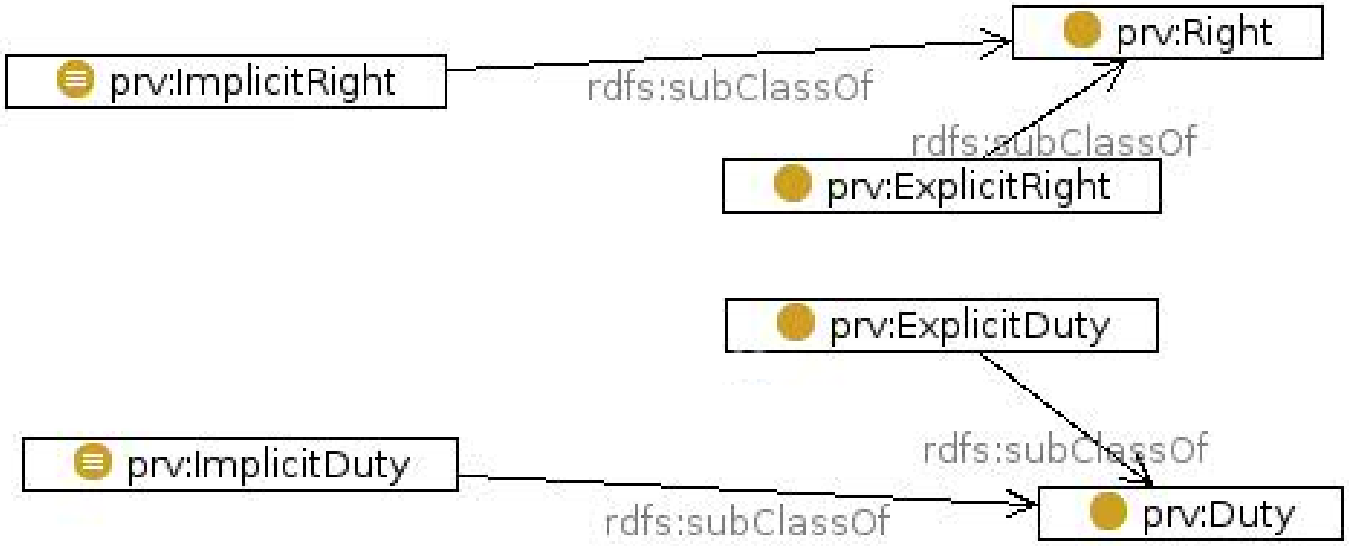
Key factor is the quality of legal knowledge modeling

Examples in the literature


HARNESS, a legal assessment system in OWL-DL
S. van de Ven, J. Breuker, R. Hoekstra, L. Wortel, "Automated Legal Assessment in OWL 2", (2008)


F. Gandon, F., G. Governatori & S. Villata, "Normative Requirements As Linked Data." (2017)

Modeling Hohfeldian Reasoning within a DL framework



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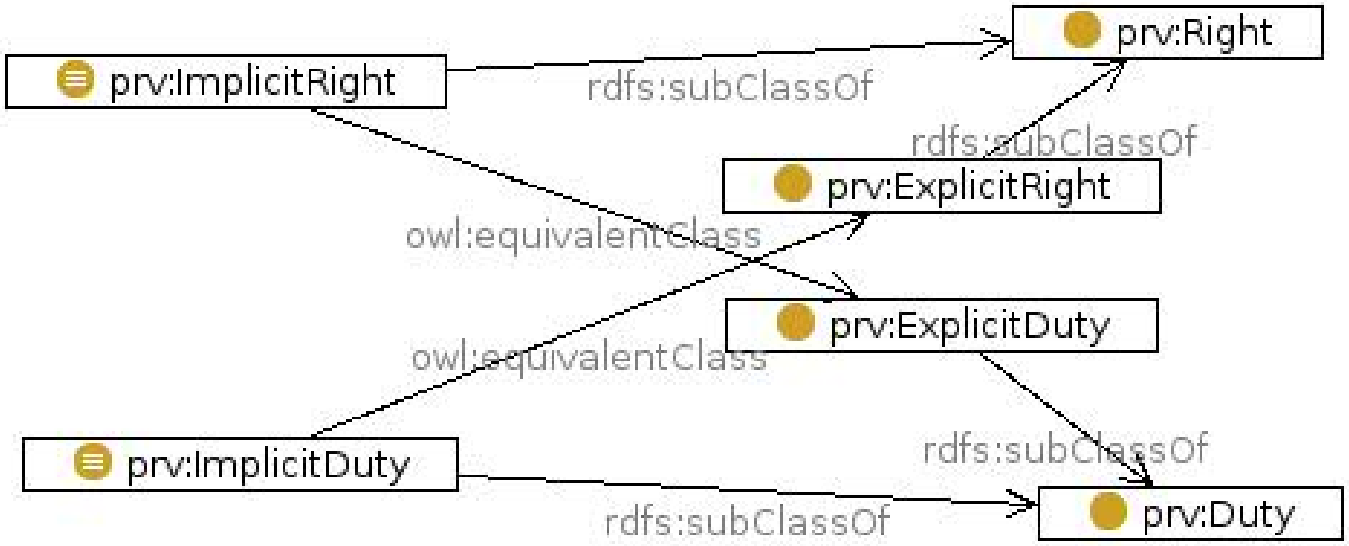


Axioms [Francesconi, 2014] [Francesconi, 2016]

ImplicitRight $\equiv$ ExplicitDuty
ImplicitDuty $\equiv$ ExplicitRight

"A Description Logic Framework for Advanced Accessing and Reasoning over Normative Provisions" (AI and Law Journal, 2014)

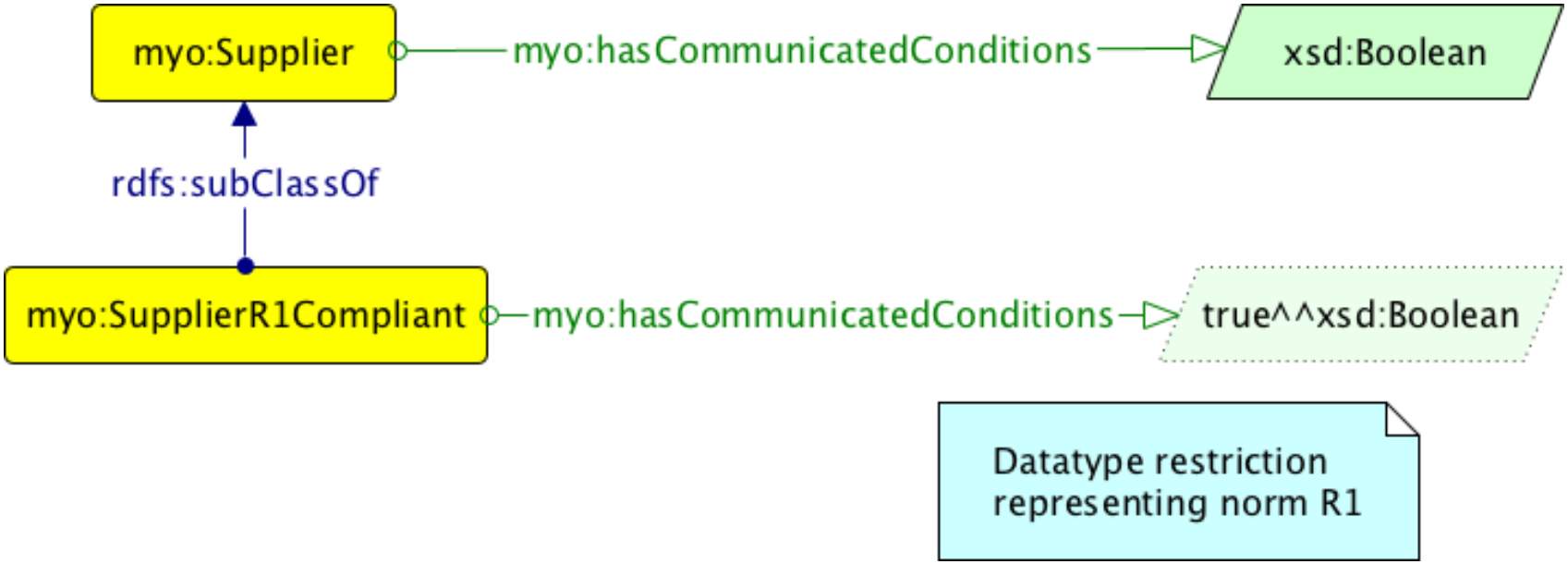
"Semantic Model for Legal Resources: Annotation and Reasoning over Normative Provisions", (Semantic Web Journal, 2016)

Modeling Legal Compliance checking within a DL framework

Regulated scenario represented as a domain ontology

Modeling Legal Compliance checking within a DL framework

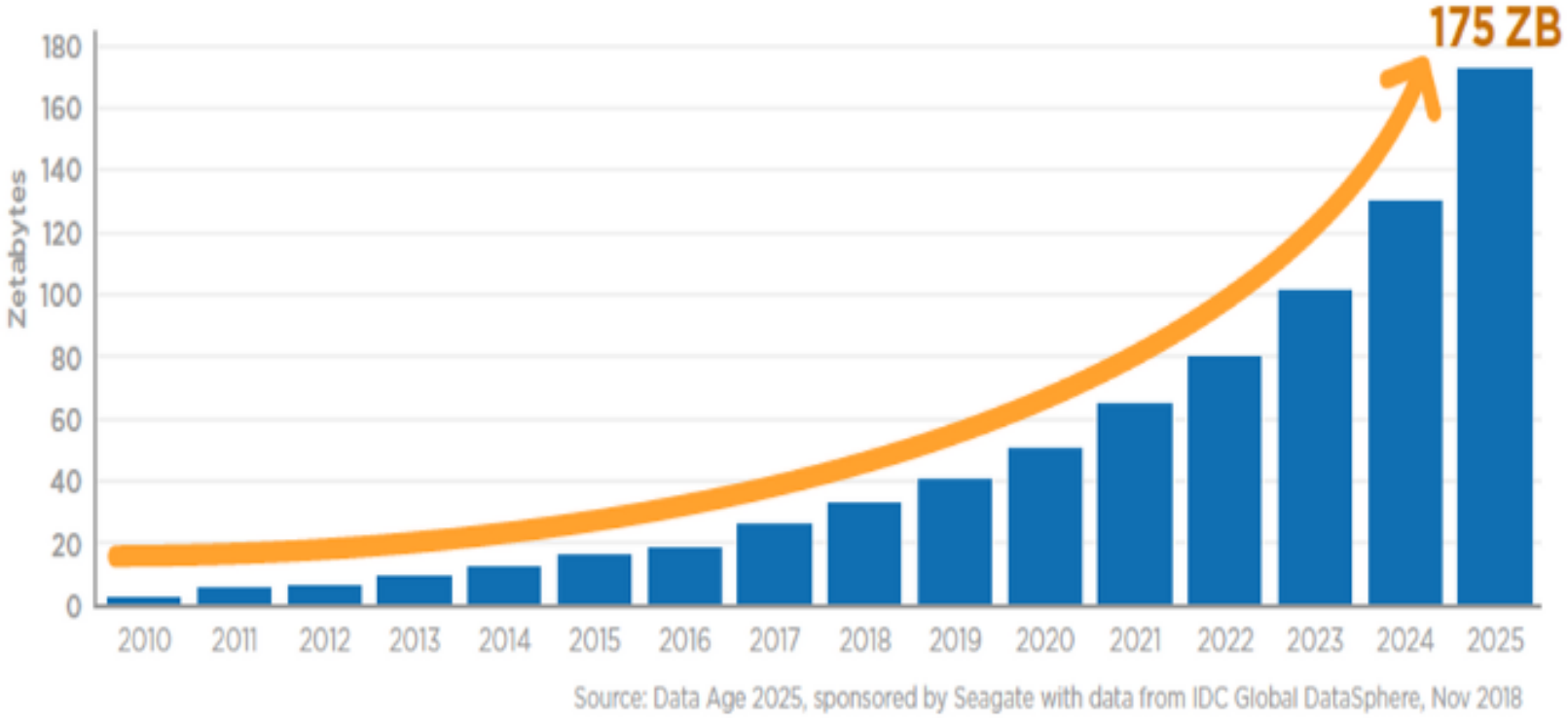
Deontic rules expressed as property restrictions
Ability to cope with some profiles of norms defeasibility



E. Francesconi, "Reasoning with Deontic Notions in a Decidable Framework" (Knowledge of the Law in the Big Data Age, 2019)
E. Francesconi, G. Governatori, "Legal Compliance in a Linked Open Data Framework", (Jurix 2019)

Opportunities

Data Growth Prediction



Opportunities for AI in the Legal Semantic Web

Seizing the opportunities of the next Data Wave

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Seizing the opportunities of the next Data Wave

Combining top-down and bottom-up approaches

- Semantic Web standards and inference tools for legal reasoning
- Machine / Deep learning for legal knowledge extraction
- Data for systems evaluation compared to existing baselines

Opportunities for AI in the Legal Semantic Web

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- Semantic Web standards and inference tools for legal reasoning
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Exploiting interoperability between information systems

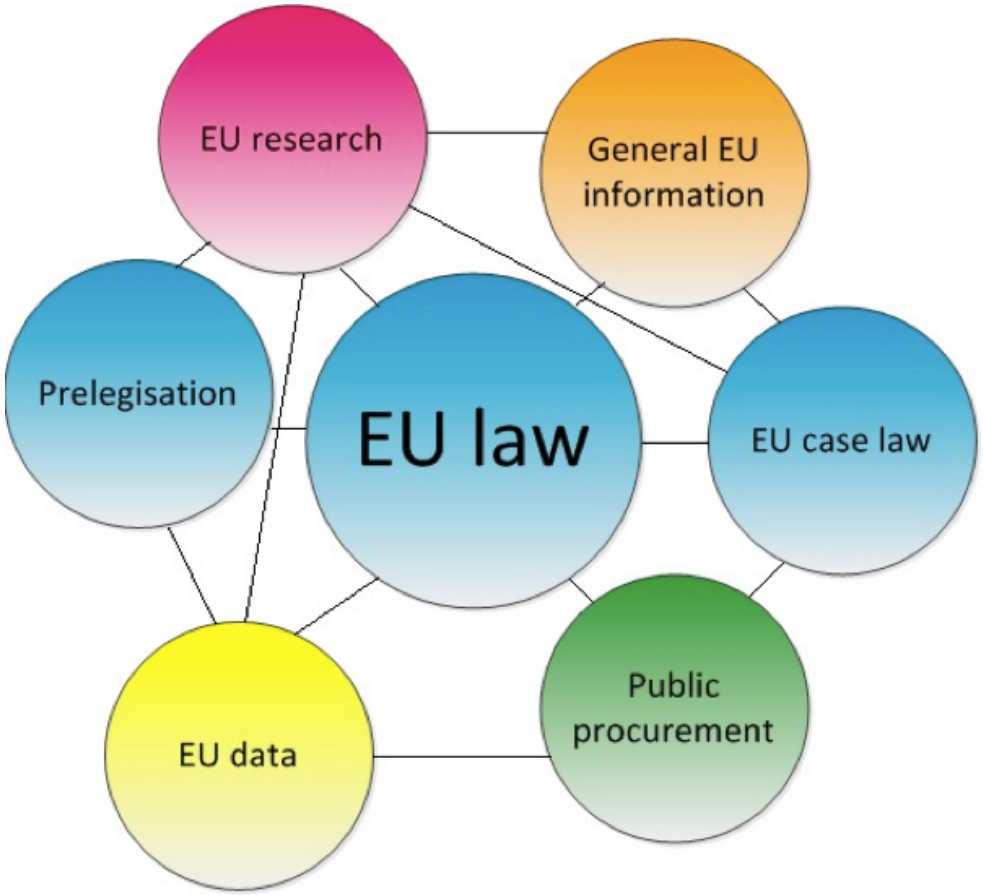
Policy for AI

- Creation of excellence and testing centres that can combine European, national and private investments
- New public private partnership in AI, data and robotics
- Promoting the adoption of AI by the Public Sector
- An Ecosystem of Trust: Regulatory Framework for AI (ex: data protection, privacy, non-discrimination)

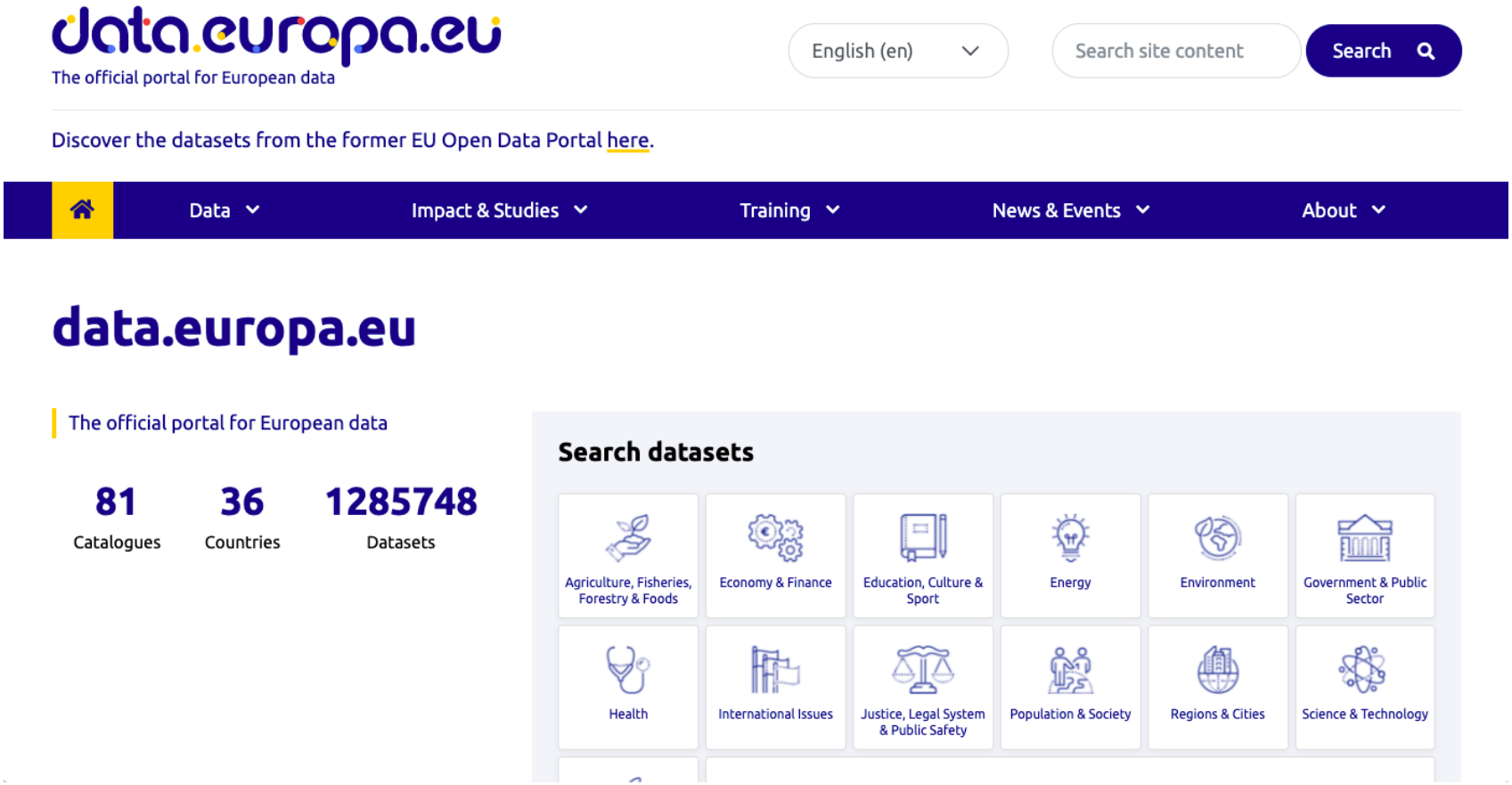
White Paper On Artificial Intelligence
A European approach to excellence and trust

(European Commission)

EU Open Data cloud – The Cellar LOD repository



EU Open Data Portal



European Parliament Open Data Portal (by 2021)

http://data.europarl.europa.eu

The Hype of Legal Tech companies and start-ups

Bill Henderson

Professor of Law at Indiana University Maurer School of Law

Legal institutions and lawyers [...] will change more radically in less than two decades than they have over the past two centuries.

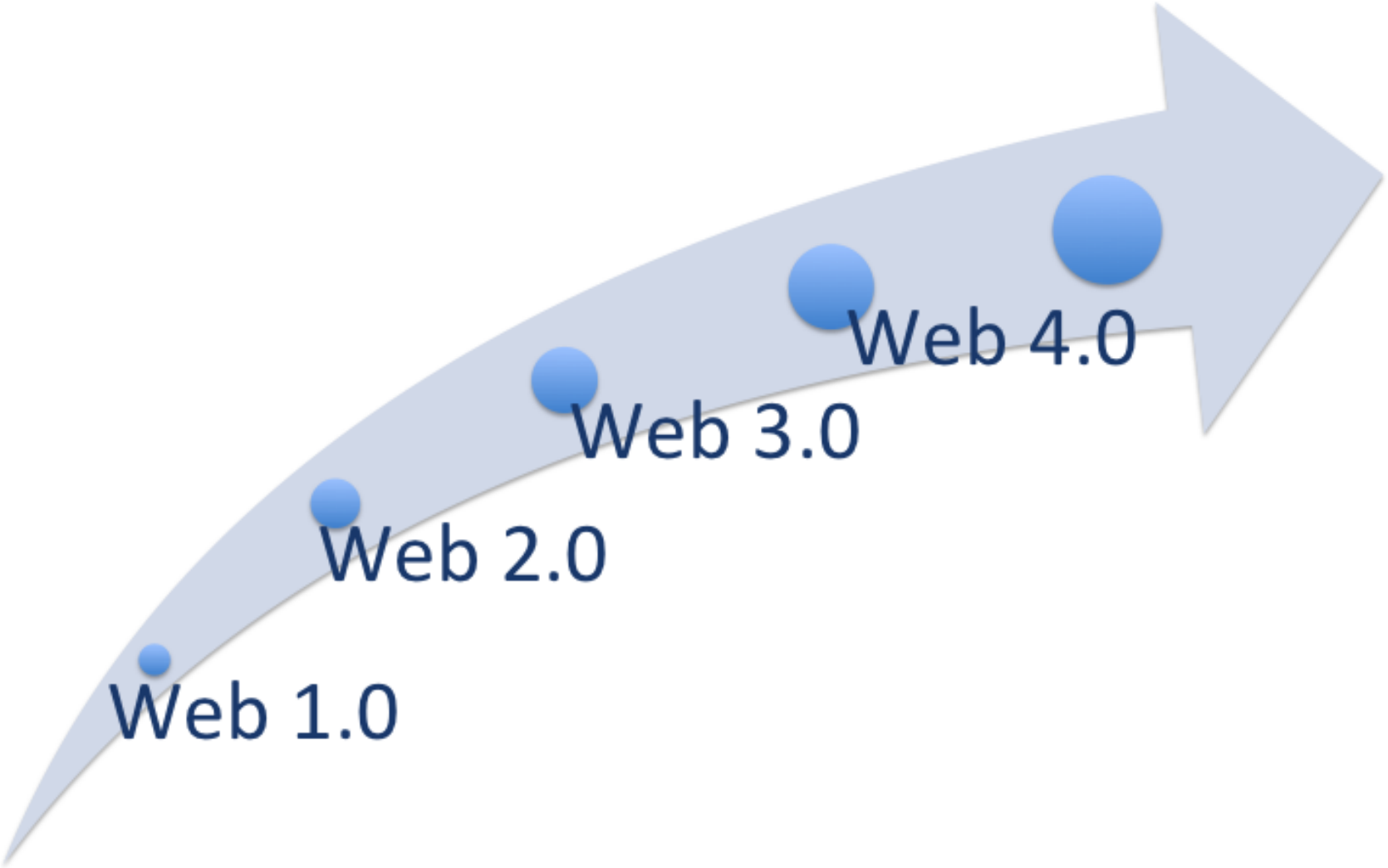
Richard Susskind
Tomorrow's Lawyers (2nd ed. 2016)
Invited Speaker at ICAIL 2017

Plenty of law firms are interested in hearing about what our research can offer

Katie Atkinson
Presidential Address at ICAIL 2017

Dreaming in the Summer of AI

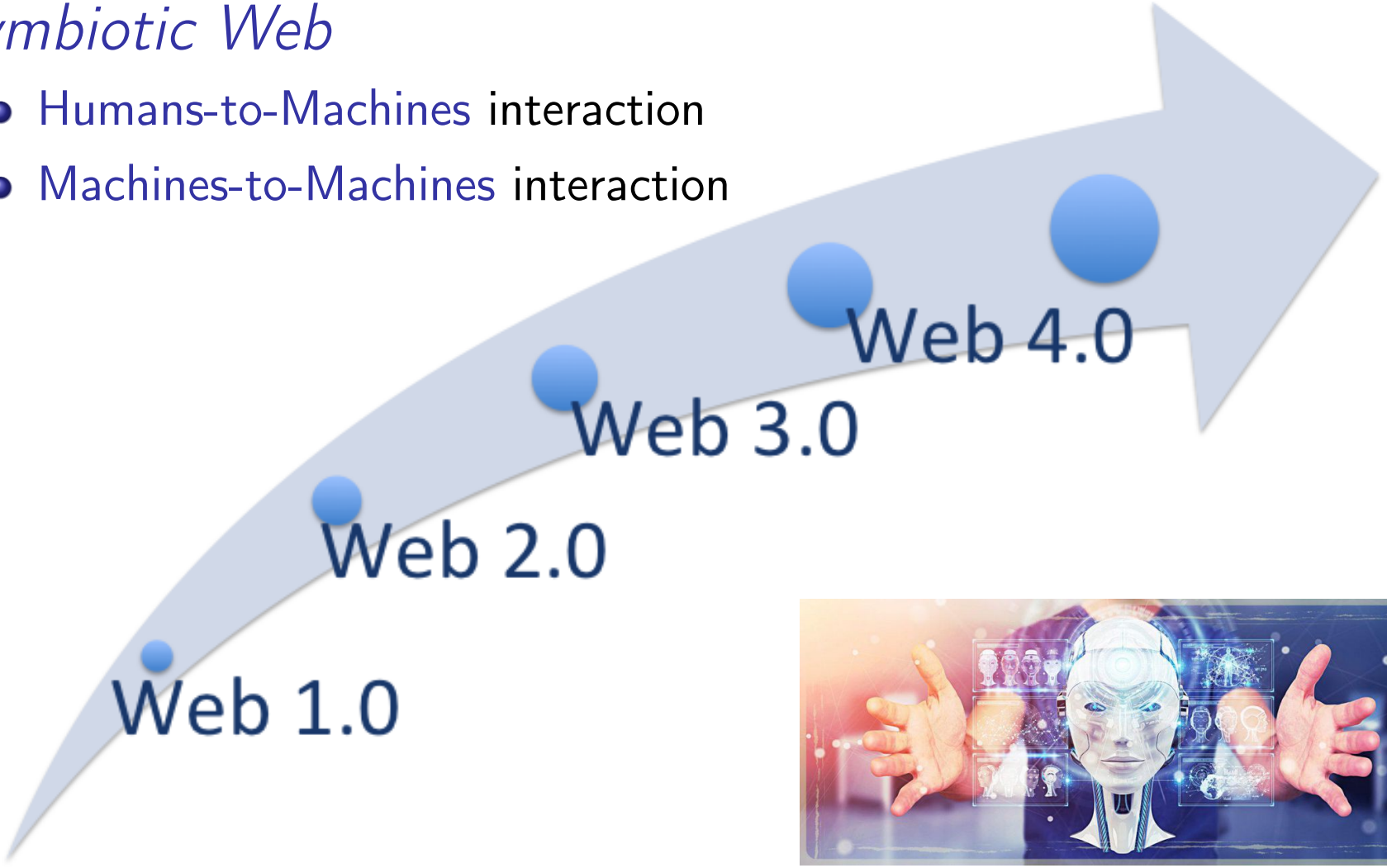
What's next? The Web 4.0



What's next? The Web 4.0

Symbiotic Web

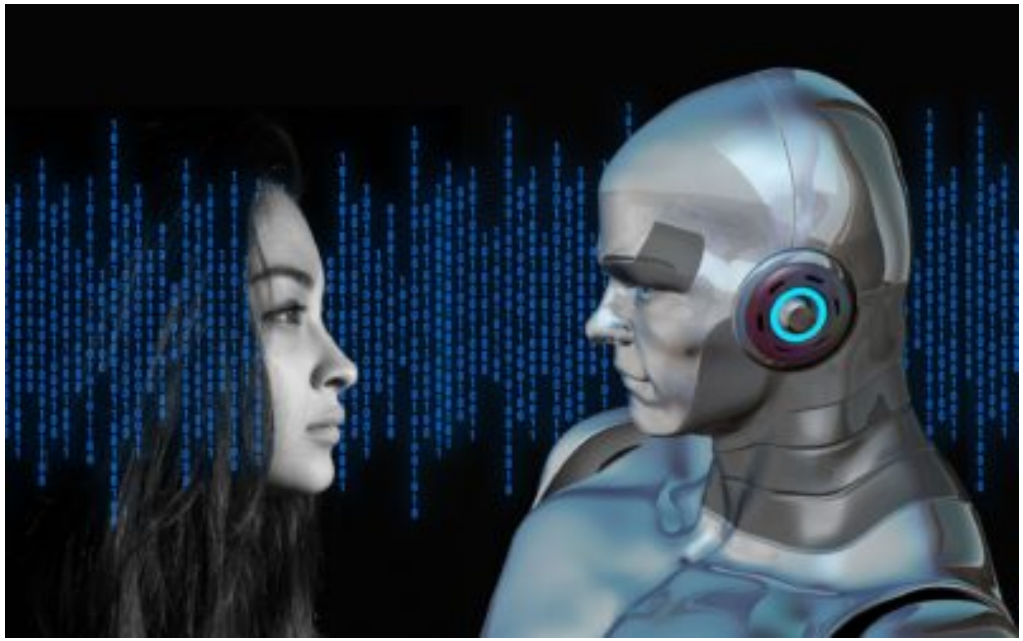
- Humans-to-Machines interaction
- Machines-to-Machines interaction



Web 4.0 Intelligent Agents

Personal software agents for

- booking flights
- making the best economic investment according to the users' financial risk profile
- autonomous (self-driving) cars
- etc.

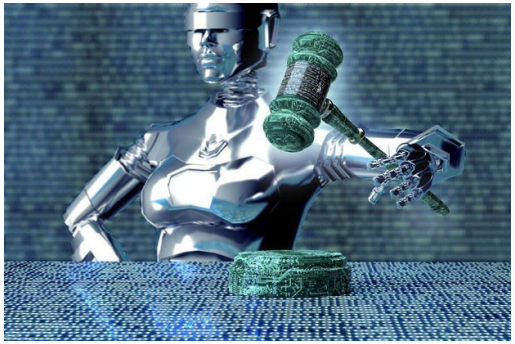


Web 4.0 for eLaw and eJustice

- In Web 3.0

  Law understandable and processable by machines

- In Web 4.0
  - Intelligent Agents for Legal data mining and e-Discovery
  - Digital Judges with knowledge of personal profiles, specific cases and laws, taking decisions on legal disputes



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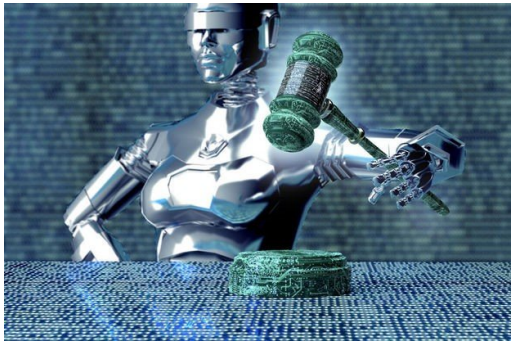
To what extent an Algorithm will be able to substitute/support Human Legal Reasoning?



AI and the Time of Human Equivalence T_0

The paradox of Hans Moravec (Carnegie Mellon University)

Existence of the Time of Human Equivalence (T_0) so that Artificial Intelligence and Human Intelligence will be no more distinguishable

(in *Mind Children. The future of robot and Human Intelligence* (1988))

$$\exists T_0 \Rightarrow \mathrm{AI}(T_0) = \emptyset$$

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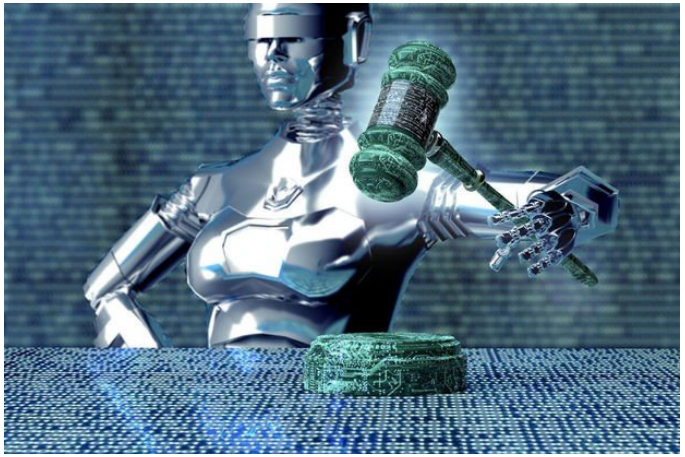
Will it be the End of AI Research?

Will a machine substitute the human legal reasoning?

Does a Human Judge argue by deductive categories only?



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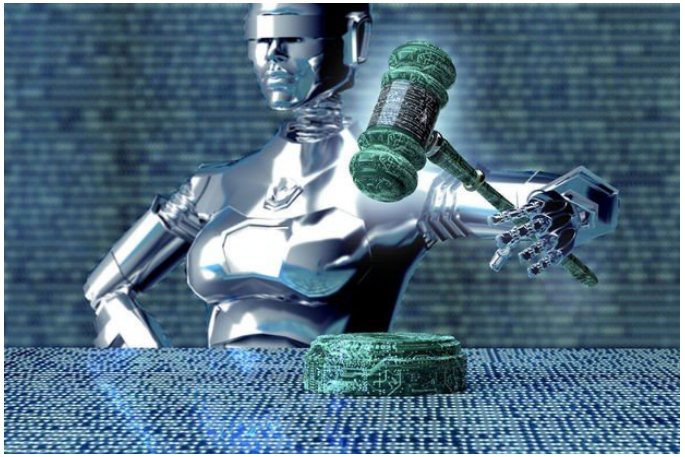

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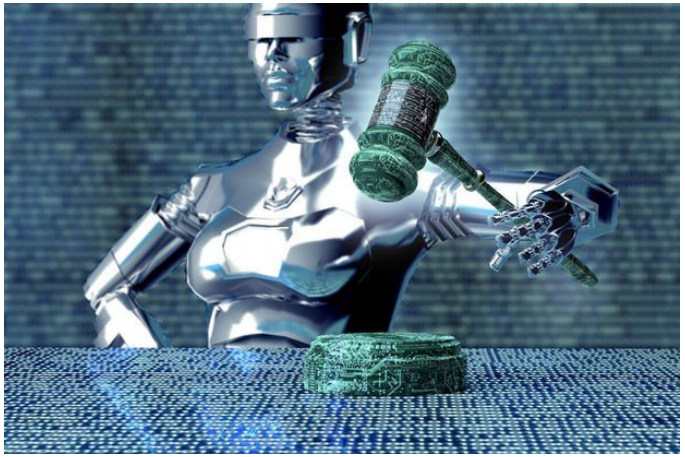
- Will a Digital Judge, emotionally neutral, be fairer than a Human Judge?



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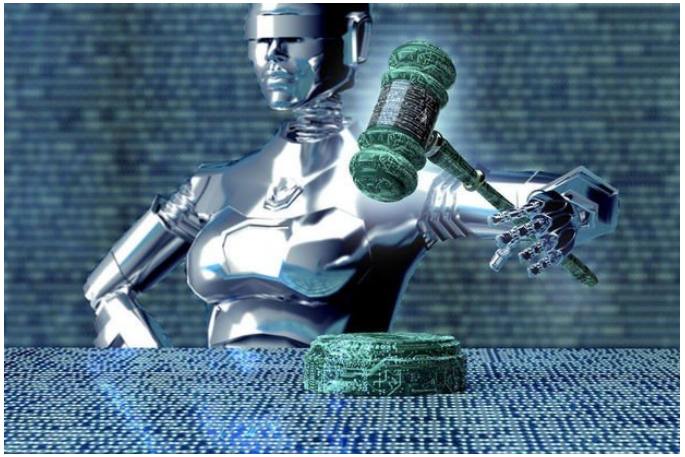
- Is the Human Brain algorithmic?



Gödel and the Incompletness Theorem

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- "*Truths that cannot be proved*" means that they cannot be derived automatically
- A computer is a set of circuits that reproduces logical (coherent, consistent) rules of thought ⇒ " incomplete" system
- Humans guess as "true" claims not derived automatically (they guess the axioms)

Human Brain and Gödel's theorem

Human Brain seems to reconcile Consistency and Completeness of a system of rules

Human Brain and Gödel's theorem

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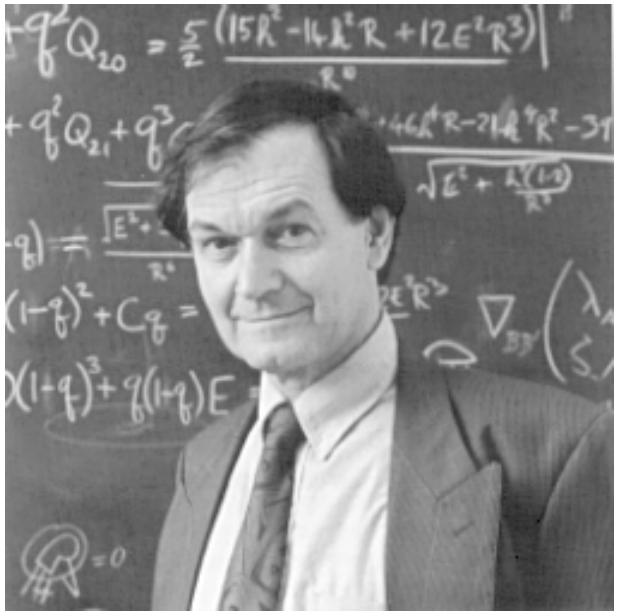
- Is Human Brain an exception to Gödel's theorem?

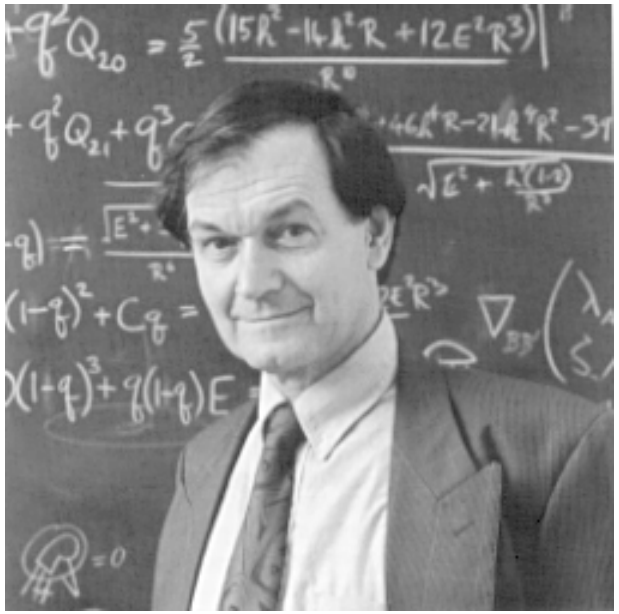
Human Brain and Gödel's theorem

Roger Penrose (Oxford University)

Human Brain is not algorithmic



Human Brain and Gödel's theorem



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Human Brain is not a Turing Machine

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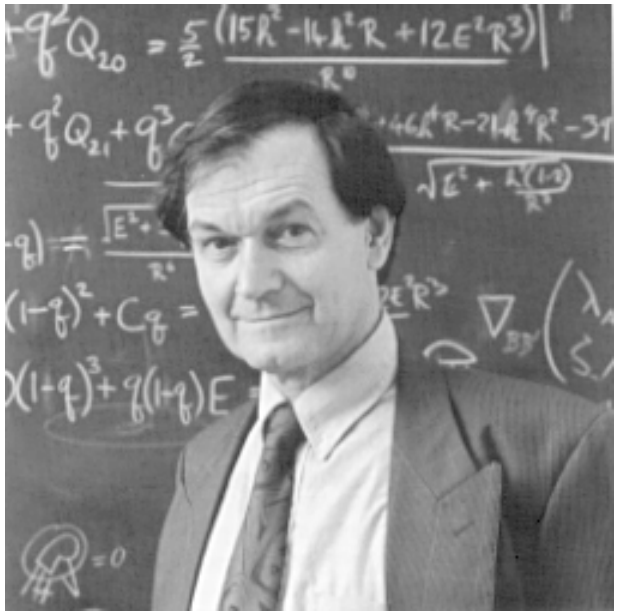

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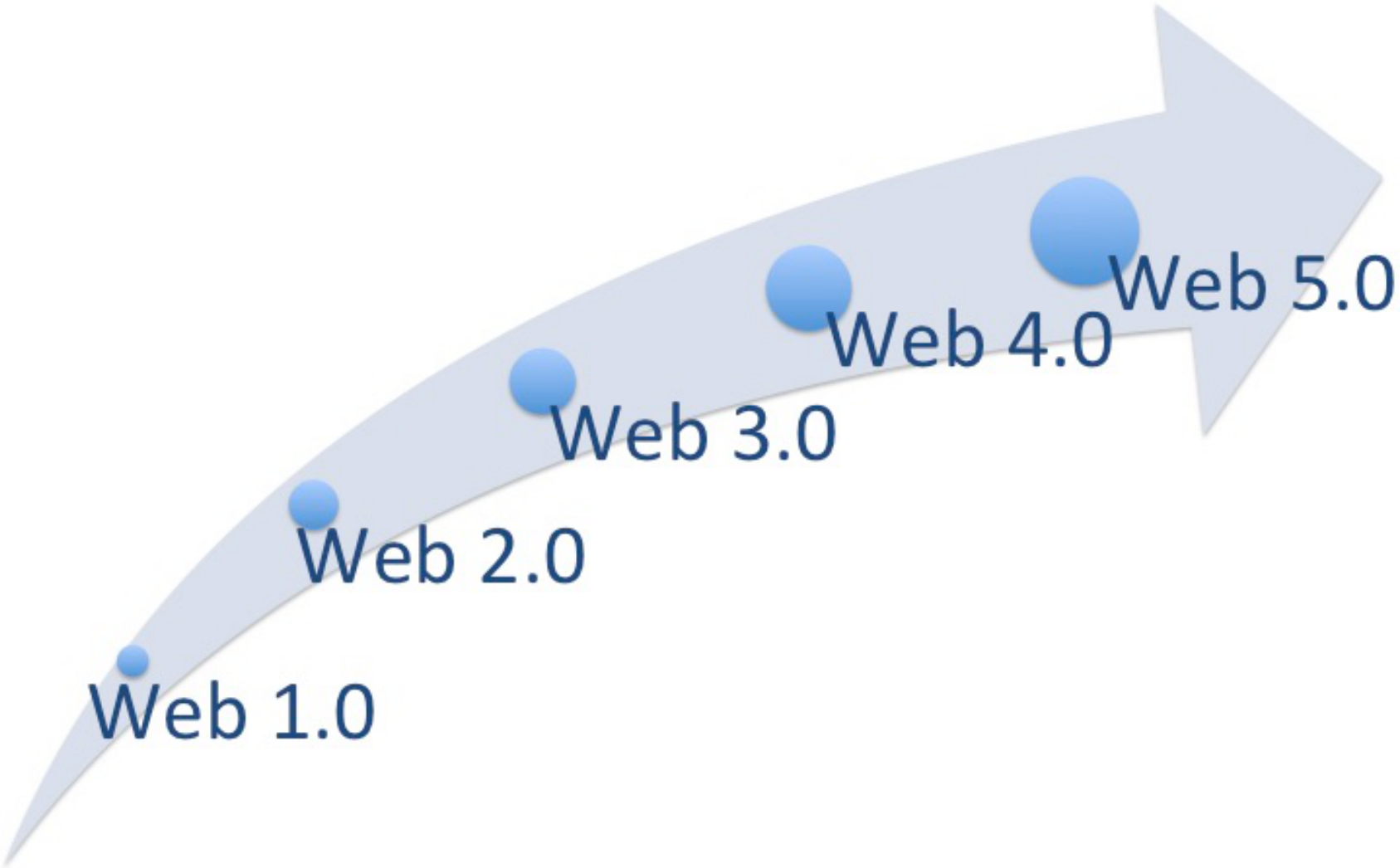
To get closer to Human Intelligence
will AI have to manage Emotions and Intuitions?

Lots of Knowledge is Intuitive

Yoshua Bengio
Invited Speaker at ICAIL 2019

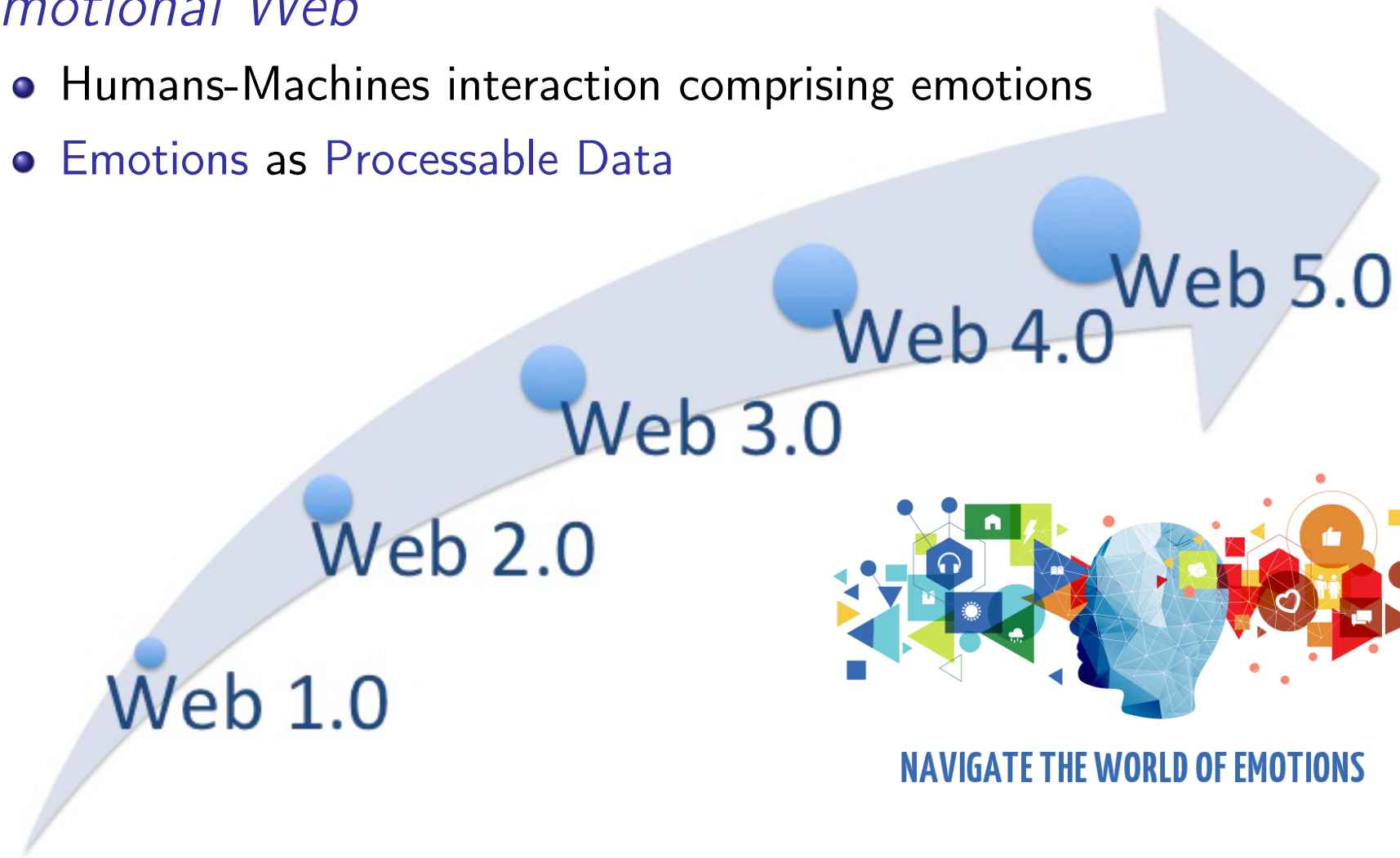
Nowadays the Web is *emotionally neutral*: next? Web 5.0



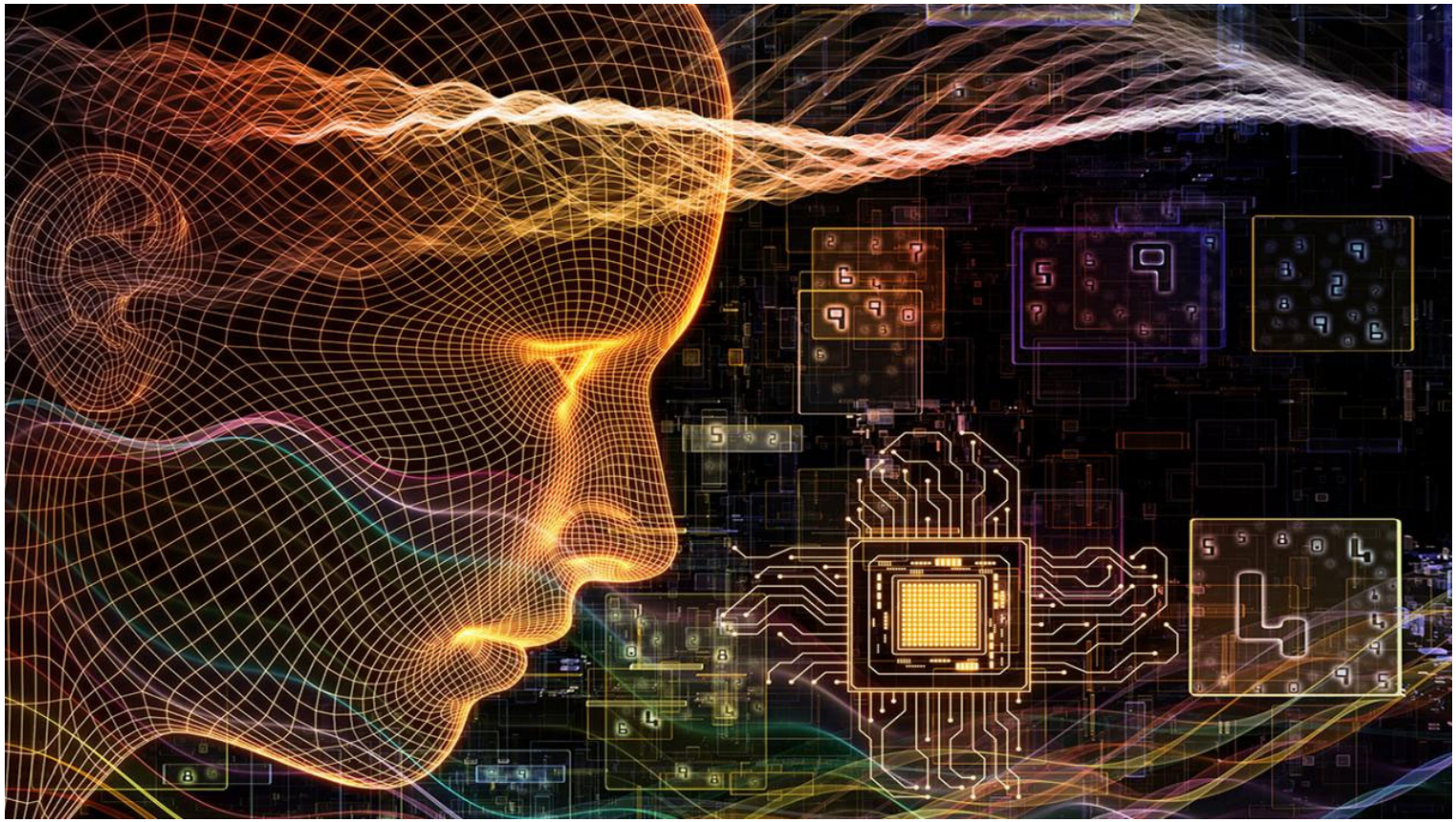
Nowadays the Web is *emotionally neutral*: next? Web 5.0

Emotional Web

- Humans-Machines interaction comprising emotions
- Emotions as Processable Data



A matter for Quantum Computing?



In the Web 5.0
how will you be able to persuade a Digital Judge?

Thanks for your attention!

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