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Alma Mater Studiorum Università di Bologna
Research Centre of History of Law,
Philosophy and Sociology of Law,
Computer Science and Law

Hybrid AI for Legal Domain

Monica Palmirani
CIRSFID, University of Bologna

LegalRuleML

HYPERMODELEX

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OASIS

Outline

- Legal Knowledge modelling framework
- Hybrid AI in Legal Domain
- Legal Ontologies: some lessons learnt
- Methodology: from the legal text to legal rules passing through legal ontology
- Example: Derogations in Legislation
- Example: Privacy Regulation and Privacy Policy
- Example: Decisions/Requests in Legal domain
- Take away

THE TECHNOLOGY 202

ChatGPT is now writing legislation. Is this the future?

Analysis by Cristiano Lima
with research by Aaron Schaffer

January 23, 2023 at 8:55 a.m. EST

But in what may be a first, a Massachusetts state senator has used a surging new tool to help write a bill aimed at restricting it: ChatGPT, the artificial intelligence chatbot.

Regular Articles

Artificial Intelligence (AI) in parliaments – preliminary analysis of the Eduskunta experiment

Fotios Fitsilis

Pages 621-633 | Published online: 10 Sep 2021

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GPT Takes the Bar Exam

December 29, 2022

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2 Bucerius Law School (Hamburg, Germany)
3 CodeX - The Stanford Center for Legal Informatics (Stanford, CA USA)

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Abstract

Nearly all jurisdictions in the United States require a professional license exam, commonly referred to as "the Bar Exam," as a precondition for law practice. To even sit for the exam, most jurisdictions require that an applicant completes at least seven years of post-secondary education, including three years at an accredited law school. In addition, most test-takers also undergo weeks to months of further, exam-specific preparation. Despite this significant investment of time and capital, approximately one in five test-takers still score under the rate required to pass the exam on their first try. In the face of a complex task that requires such depth of knowledge, what, then, should we expect of the state of the art in "AI?" In this research, we document our experimental evaluation of the performance of OpenAI's TEXT-DAVINCI-003 model, often-referred to as GPT-3.5, on the multistate multiple choice (MBE) section of the exam. While we find no benefit in fine-tuning over GPT-3.5's zero-shot performance at the scale of our training data, we do find that hyperparameter optimization and prompt engineering positively impacted GPT-3.5's zero-shot performance. For best prompt and parameters, GPT-3.5 achieves a headline correct rate of 50.3% on a complete NCBE MBE practice exam, significantly in excess of the 25% baseline guessing rate, and performs at a passing rate for both Evidence and Torts. GPT-3.5's ranking of responses is also highly-correlated with correctness; its top two and top three choices are correct 71% and 88% of the time, respectively, indicating very strong non-entailment performance. While our ability to interpret these results is limited by nascent scientific understanding of LLMs and the proprietary nature of GPT, we believe that these results strongly suggest that an LLM will pass the MBE component of the Bar Exam in the near future.

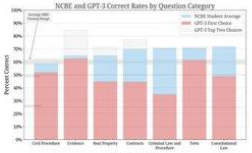

Fig 1. Summary of performance by question category for GPT-3.5 and NCBE-Reported Students

	GPT	GPT Top 2	GPT Top 3	NCBE
Evidence	63%	84%	98%	65%
Torts	62%	72%	93%	71%
Civil Procedure	52%	63%	79%	59%
Constitutional Law	49%	67%	87%	72%
Real Property	45%	72%	85%	65%
Contracts	45%	77%	86%	70%
Criminal Law & Procedure	35%	62%	86%	71%
AVERAGE	50%	71%	88%	68%

Table 2. Summary of performance by question category for GPT-3.5 and NCBE-Reported Students

NCBE vs. GPT Performance on the MBE

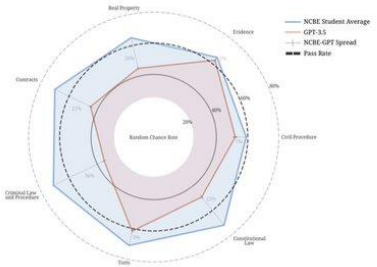

Fig 2. Accuracy by Question Category for GPT and Average Test-Takers

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Computer Law & Security Review
Volume 48, April 2023, 105772

Comment

Representing legislative Rules as Code: Reducing the problems of 'scaling up'

Andrew Mowbray [a], Philip Chung [b], Graham Greenleaf [c]

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Hallucination AI

Lawyer apologizes for fake court citations from ChatGPT

By Ramishah Maruf, CNN

Updated 3:28 PM EDT, Sun May 28, 2023

US judge orders lawyers to sign AI pledge, warning 'they make stuff up'

By Jacqueline Thomsen

May 31, 2023 8:56 PM GMT+2 · Updated 10 hours ago

Home / News / Technology / Artificial Intelligence / EU Commission issues internal guidelines on ChatGPT, generative AI

EU Commission issues internal guidelines on ChatGPT, generative AI

By Luca Bertuzzi | EURACTIV.com Est. 4min

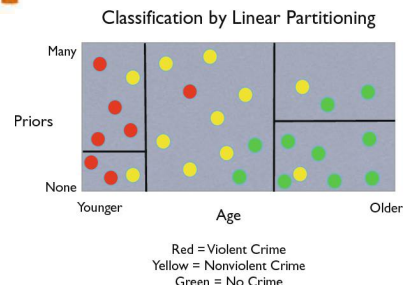
31 mag 2023

eLegal evolution

EUR-Lex

at4am

EU Open Data Portal




```
pragma solidity ^0.4.17;

contract SimpleStorage {
  uint storedData;

  function set(uint x) public {
    storedData = x;
  }

  function get() public view returns (uint) {
    return storedData;
  }
}
```

Publishing → Open Data → Workflow → Legal Analytics → AI and Smart Contract

1990s 2000s 2010s 2020s 2030s

AI and Law

Logic programming – Symbolic AI

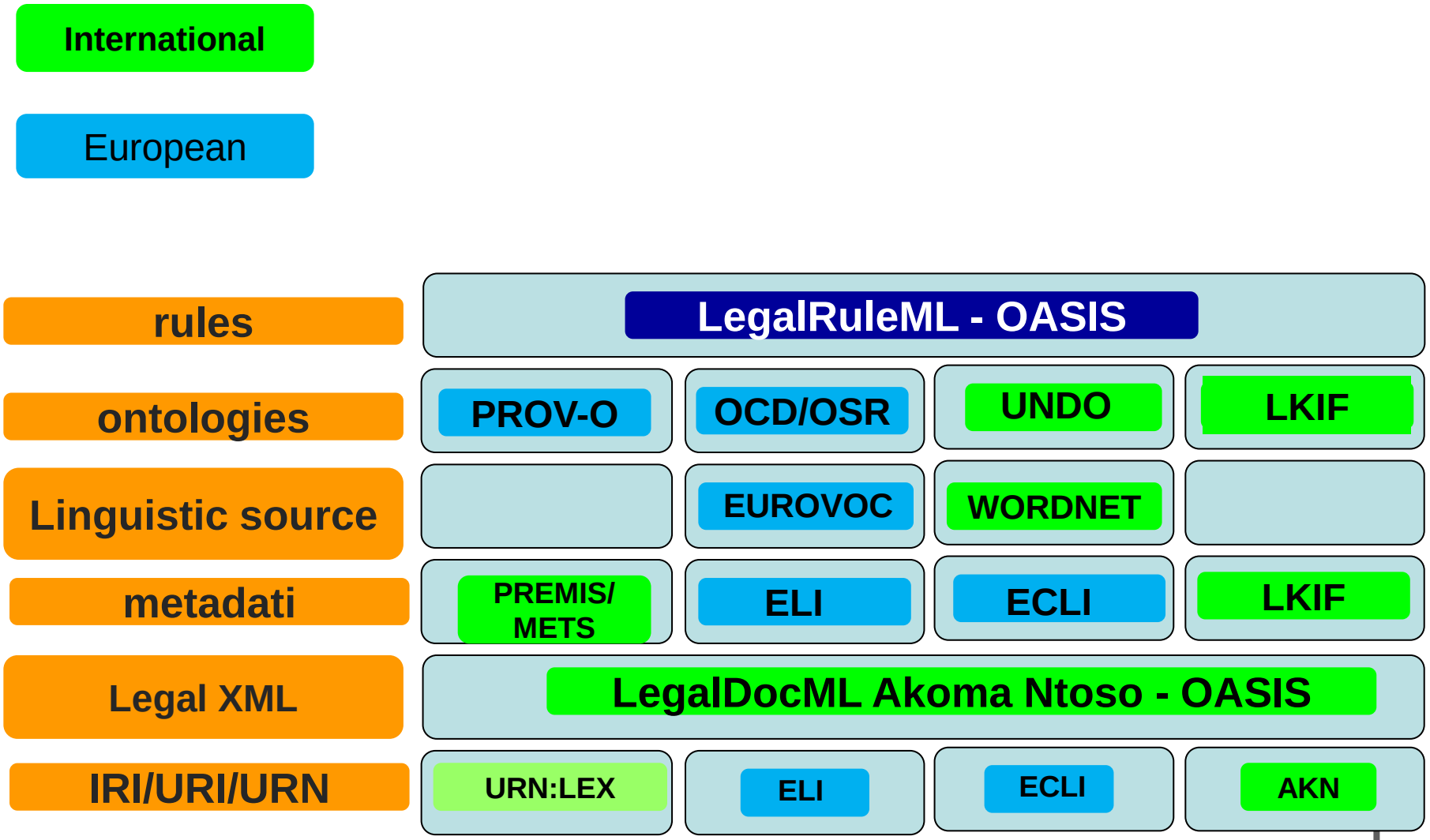
Semantic Web and Knowledge representation

ML, Classification, clustering, NLP, predict

Legal data analytics

Blockchain & Smart Contract

Legal Knowledge Modelling
Legal Semantic Web ecosystem

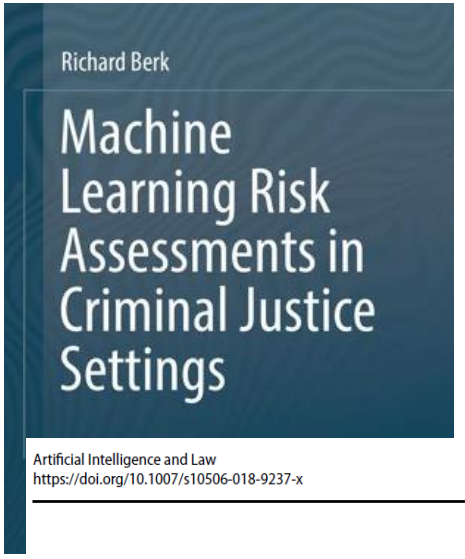


Different goals of AI in Legal Domain

1. **Generation** of the legislation/amendment/debates/summary – ***ex-ante***
2. **Modelling**/representing/classifying/extracting the source of the law– ***ex-post***
3. **Prediction** of some output– ***pro-futuro***
4. **Executing**/reasoning rules– ***real-time***

Machine learning for Legal Domain

- **Regression** → to correlate phenomena and to predict future trends (e.g., legislative impact)
- **Classification**→ text classification (e.g., derogation), classification of the facts/persons (e.g., rights/obligations)
- **Clustering** → to group documents (e.g., convergent definitions)
- **Association**→ sociological analysis using the social media (e.g., social needs)
- **Control** → optimization of the order of the day in Parliament



Artificial Intelligence and Law
https://doi.org/10.1007/s10506-018-9237-x

CrossMark

Judicial analytics and the great transformation of American Law

Daniel L. Chen[1]

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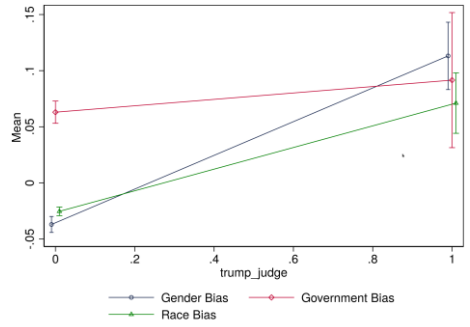
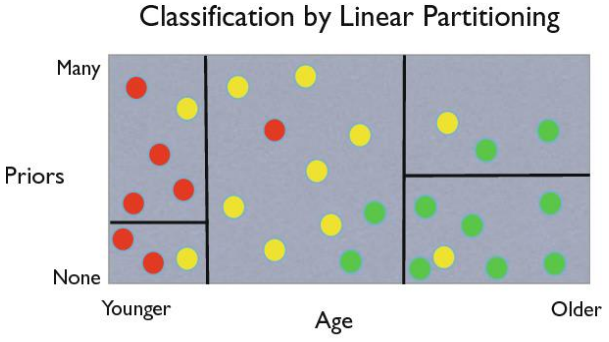
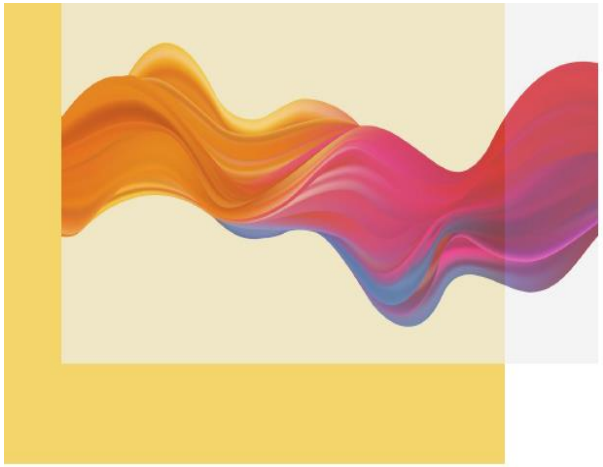




AI in legislation

- Support the **drafting/translation/planning/definitions**
  - classification, reinforcement learning
- Support of the **decision /checking compliance/ implementation of the Directive/ implementing regulation/ delegation** acts
  - similarity, association, legal reasoning, neural netwrok
- Legal system **analytics/**
  - Clustering, regression
- Predict **predict/anticipate** of the needs from the society
  - Pro-futuro



Legal Drafting in the Era of Artificial Intelligence and Digitisation

European Commission

Directorate-General for Informatics
Solutions for Legislation, Policy & HR

Weakness of ML in legal domain

- **Granularity** vs. **Structure**: ML works at sentence level and this approach is not capable to link different parts of the speech semantically connected (e.g., obligation-exception, duty-penalty)
- **Content** vs. **Context**: ML loses the context (e.g., jurisdiction, temporal parameters)
- **Past** vs. **Future**: ML depends to the past data series (e.g., new brilliant solution has no historical series)
- **Internal** vs. **External** info: ML does not consider the normative and juridical citations.
- **Static** vs. **Dynamic**: The normative references evolve over time (e.g., “art. 3” is not the same forever)

Critical issues in legal domain

- **Temporal view**

New events respect the past:

  - Definition of “European Citizenship” → Brexit
  - Trends of travels → COVID-19

- **Institution view**

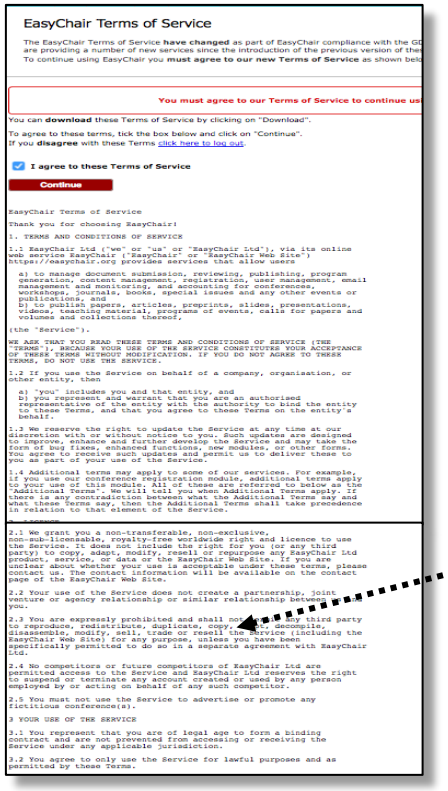
Political decisions:

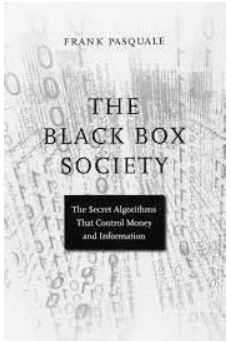
  - End of life → each country defines different solutions

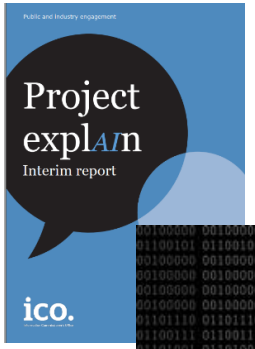
- **Values view**

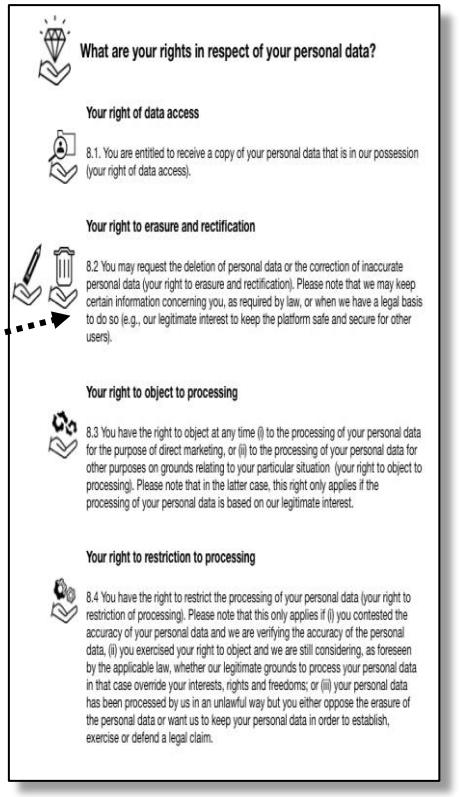
  - Algorithms (e.g., ChatGPT), dataset, data training need to be customized to each legal system context and not to be used *as-is*
  - ***Transparency, Neutrality, Impartiality, Explicability***

Transparency: Black box risk in Legal Norms Modelling







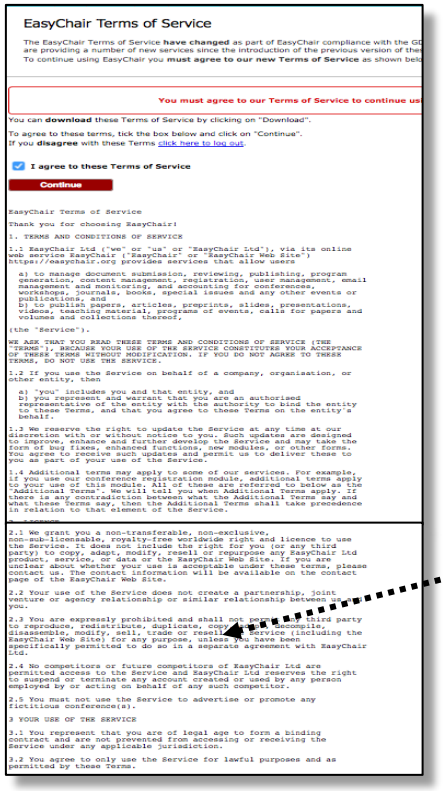


Lawyer-readable

Legal norms modelling without explicability

Human-readable

“White box” approach in AI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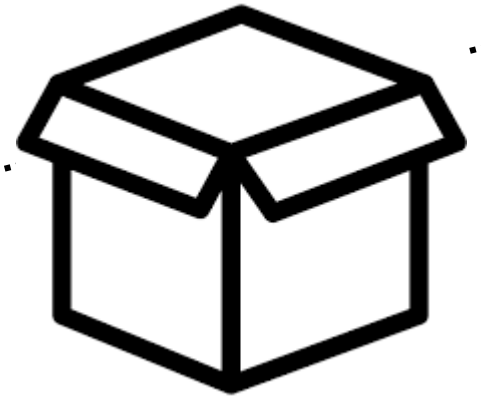
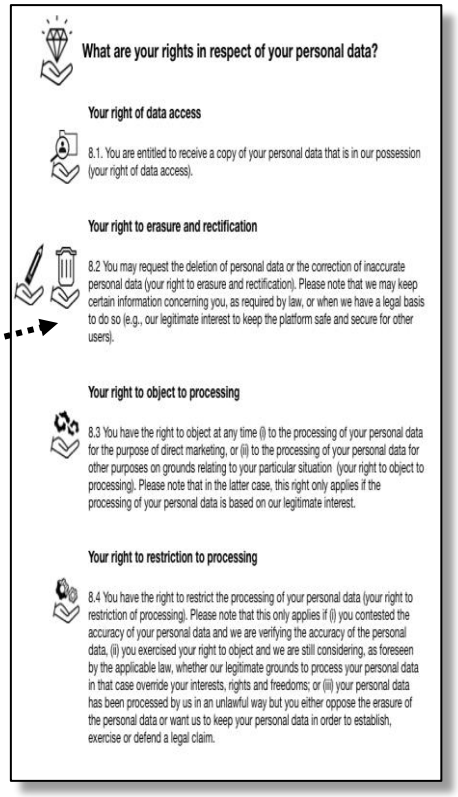
Architecture for Knowledge-Oriented Management of African Normative Texts using Open Standards and Ontologies

OASIS LegalXML

LegalRuleML




What are your rights in respect of your personal data?

Your right of data access

8.1. You are entitled to receive a copy of your personal data that is in our possession (your right of data access).

Your right to erasure and rectification

8.2 You may request the deletion of personal data or the correction of inaccurate personal data (your right to erasure and rectification). Please note that we may keep certain information concerning you, as required by law, or when we have a legal basis to do so (e.g., our legitimate interest to keep the platform safe and secure for other users).

Your right to object to processing

8.3 You have the right to object at any time (i) to the processing of your personal data for the purpose of direct marketing, or (ii) to the processing of your personal data for other purposes on grounds relating to your particular situation (your right to object to processing). Please note that in the latter case, this right only applies if the processing of your personal data is based on our legitimate interest.

Your right to restriction to processing

8.4 You have the right to restrict the processing of your personal data (your right to restriction of processing). Please note that this only applies if (i) you contested the accuracy of your personal data and we are verifying the accuracy of the personal data, (ii) you exercised your right to object and we are still considering, as foreseen by the applicable law, whether our legitimate grounds to process your personal data in that case override your interests, rights and freedoms; or (iii) your personal data has been processed by us in an unlawful way but you either oppose the erasure of the personal data or want us to keep your personal data in order to establish, exercise or defend a legal claim.

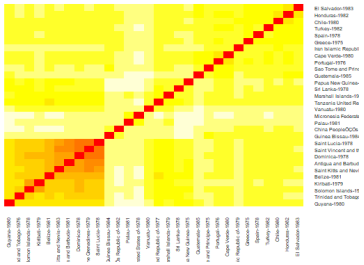
Lawyer-readable

Machine-readable

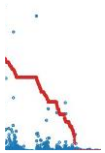
Human-readable

Hybrid AI for Legal Domain

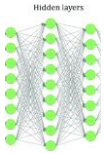
Similarity World Constitutions



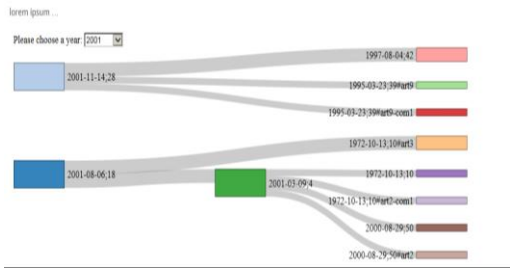
Symbolic

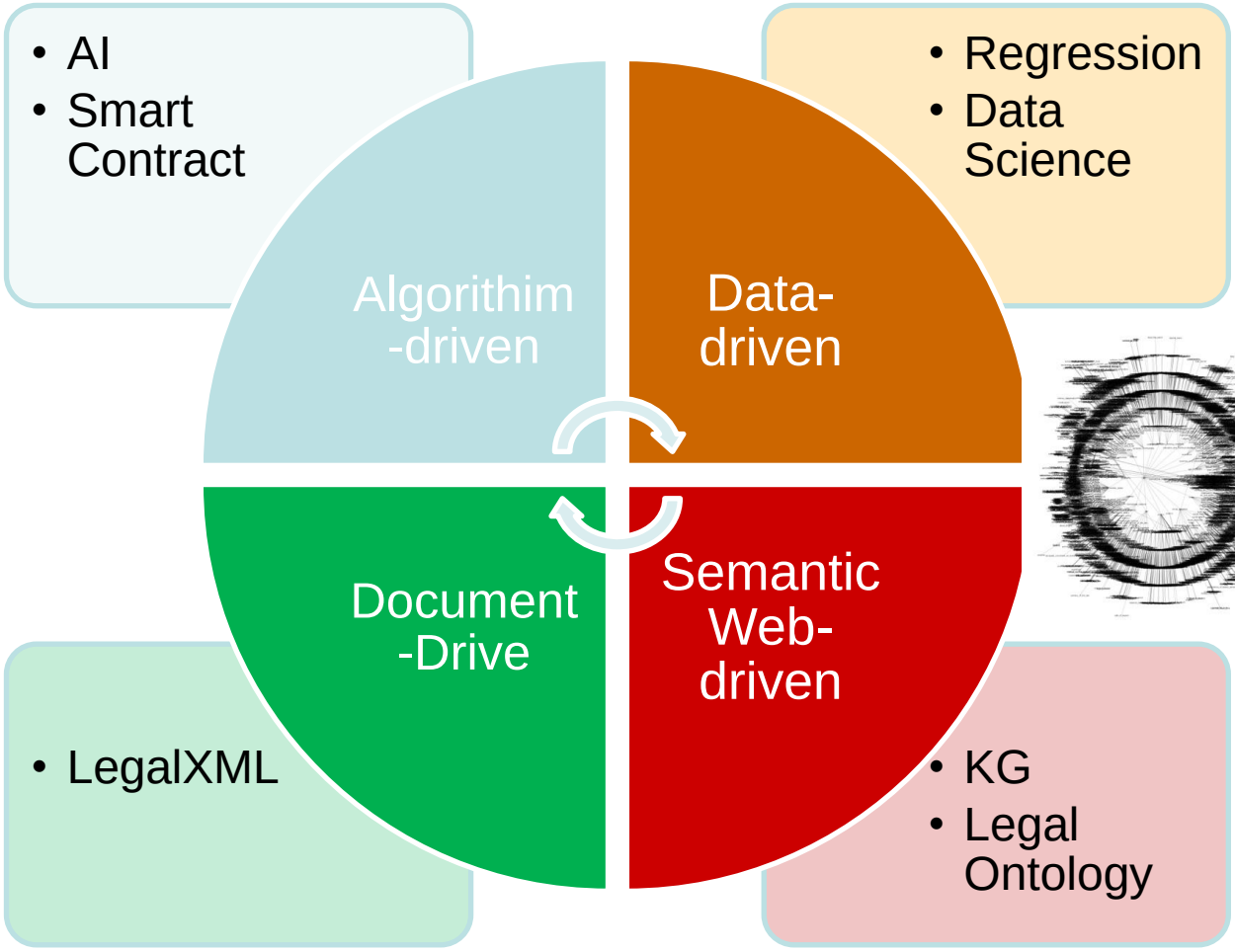


Non-Symbolic



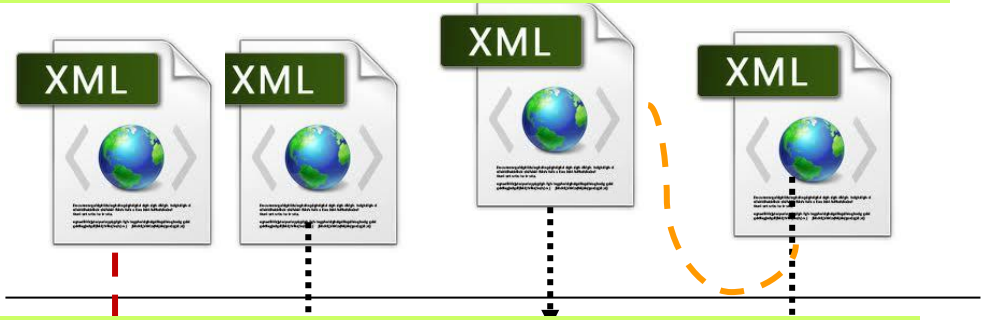
Sub-Symbolic



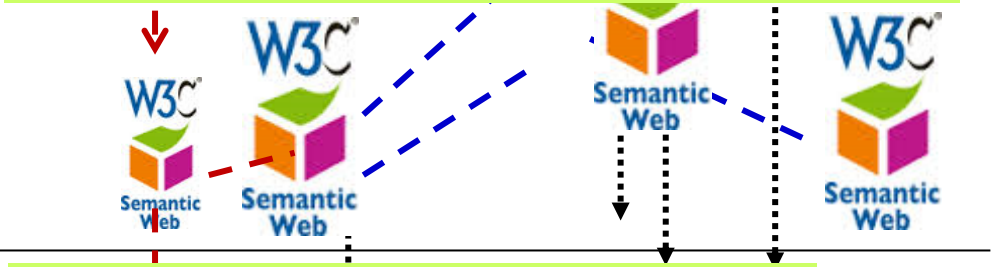


Legal Knowledge Modelling

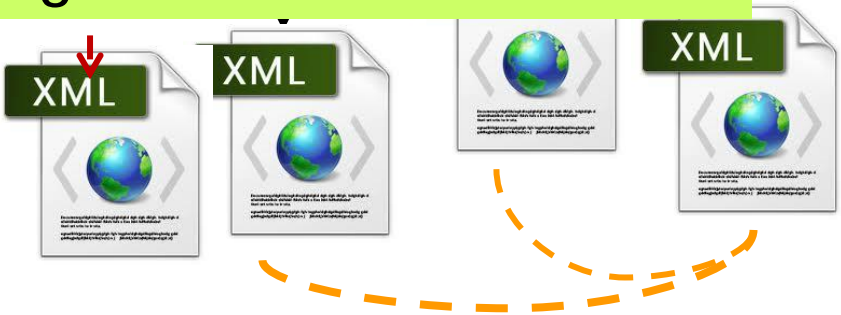
Legal document in XML - context



Legal Ontology – semantic level



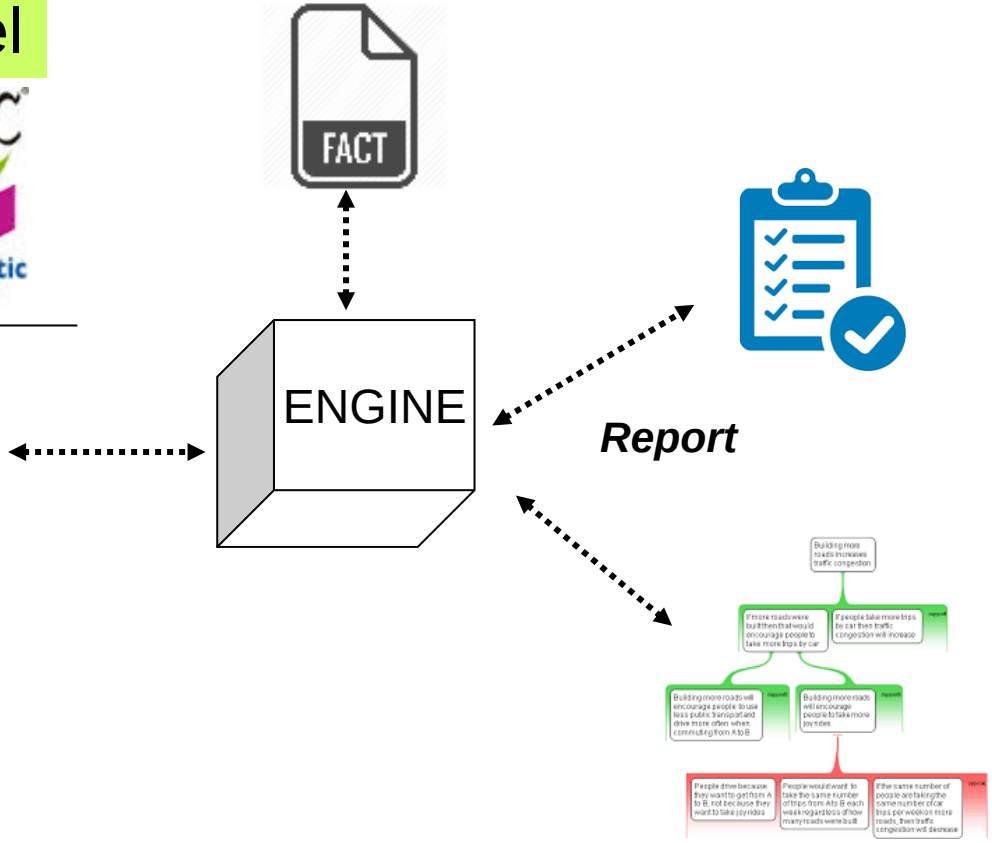
Logic Rules – deontic level



Argumentation/Justification

Services

- GOAL definition



Different levels of legal ontologies

- Legal core ontologies – Legal person
- Legal document ontologies – Consolidation, definitions, modifications
- Legal process ontologies – Parlament law-making process
- Legal domain ontologies – IPR, Privacy, eCommerce, eTender, eJustice, etc.
- Legal rules ontologies – Legal reasoning
- Legal Linguistic ontologies - Eurovoc

Expert Systems With Applications 130 (2019) 12–30

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Legal ontologies over time: A systematic mapping study

Cleyton Mário de Oliveira Rodrigues[a,b,*], Frederico Luiz Gonçalves de Freitas[b], Emanoel Francisco Spósito Barreiros[a], Ryan Ribeiro de Azevedo[c], Adauto Trigueiro de Almeida Filho[a]

[a] University of Pernambuco, Garanhuns-PE, ZIP 55294-902, Brazil
[b] Federal University of Pernambuco, Center of Informatics (CIn/UFPE) P.O. Box 7851, Recife-PE, Brazil
[c] Federal Rural University of Pernambuco, (UAG) ZIP 55292-270, Garanhuns-PE, Brazil

4315 papers

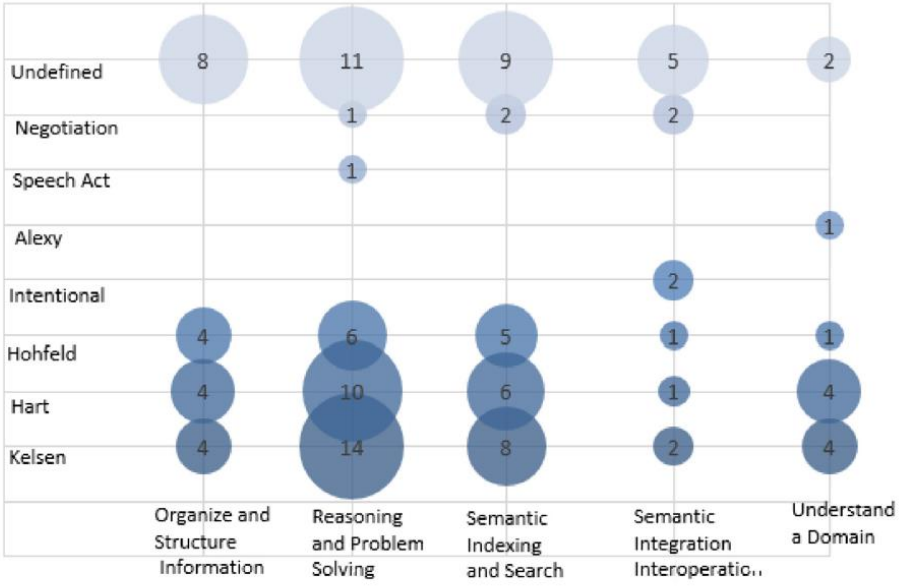


Fig. 4. Legal theories by purpose of ontology.

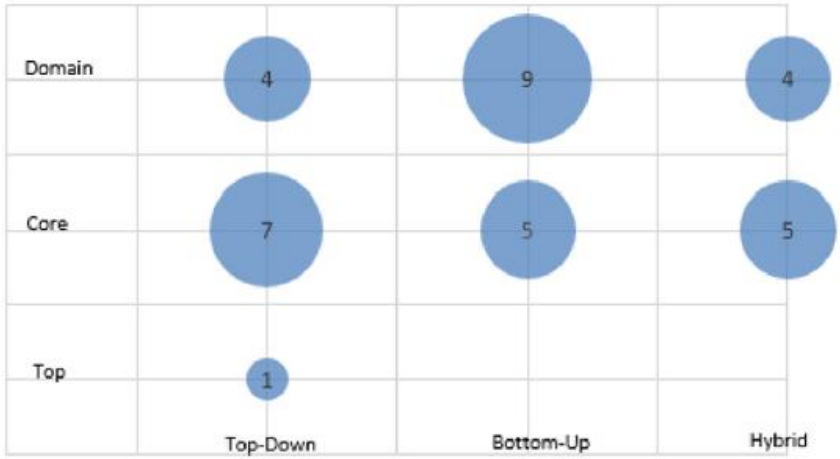
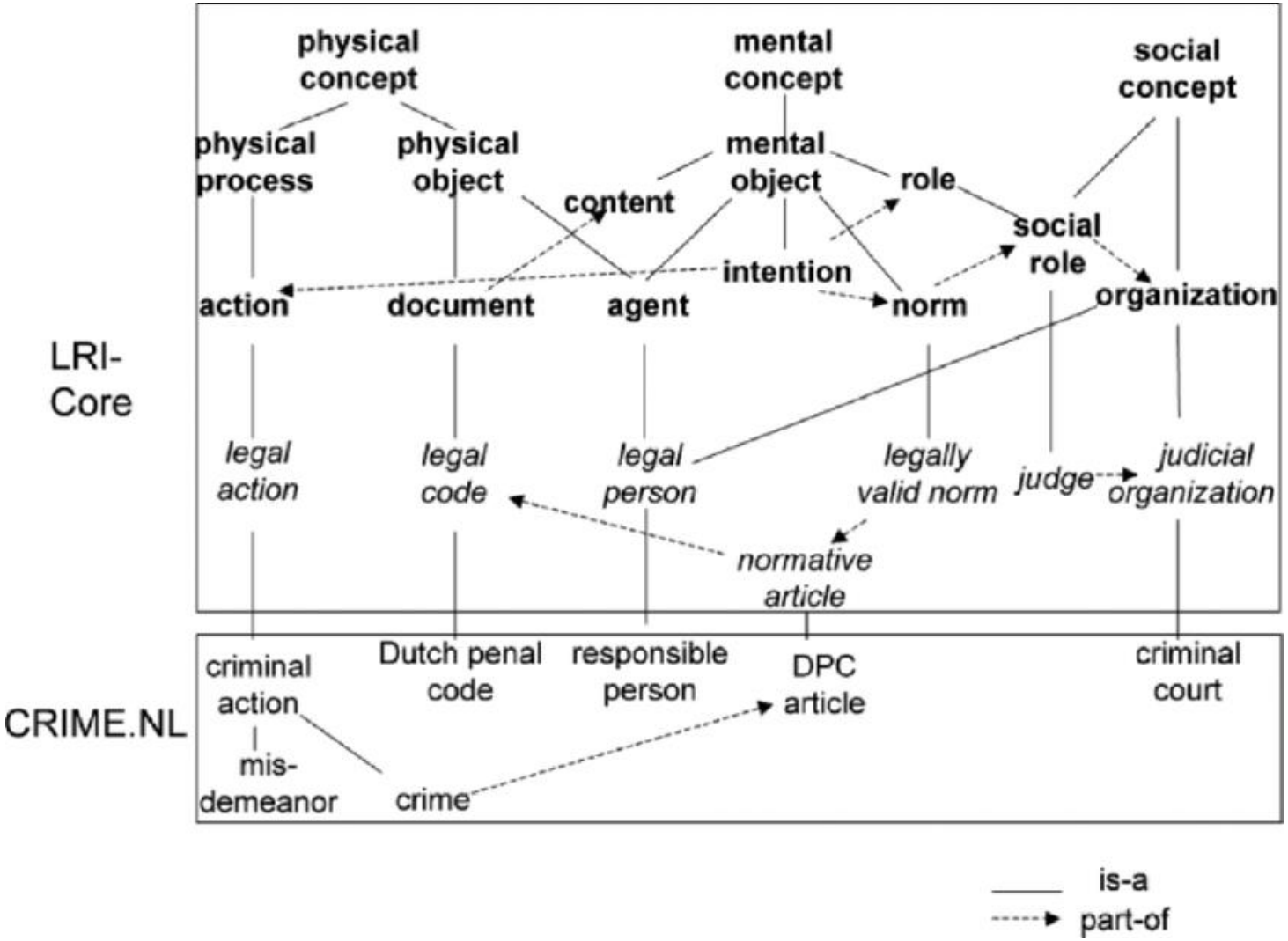


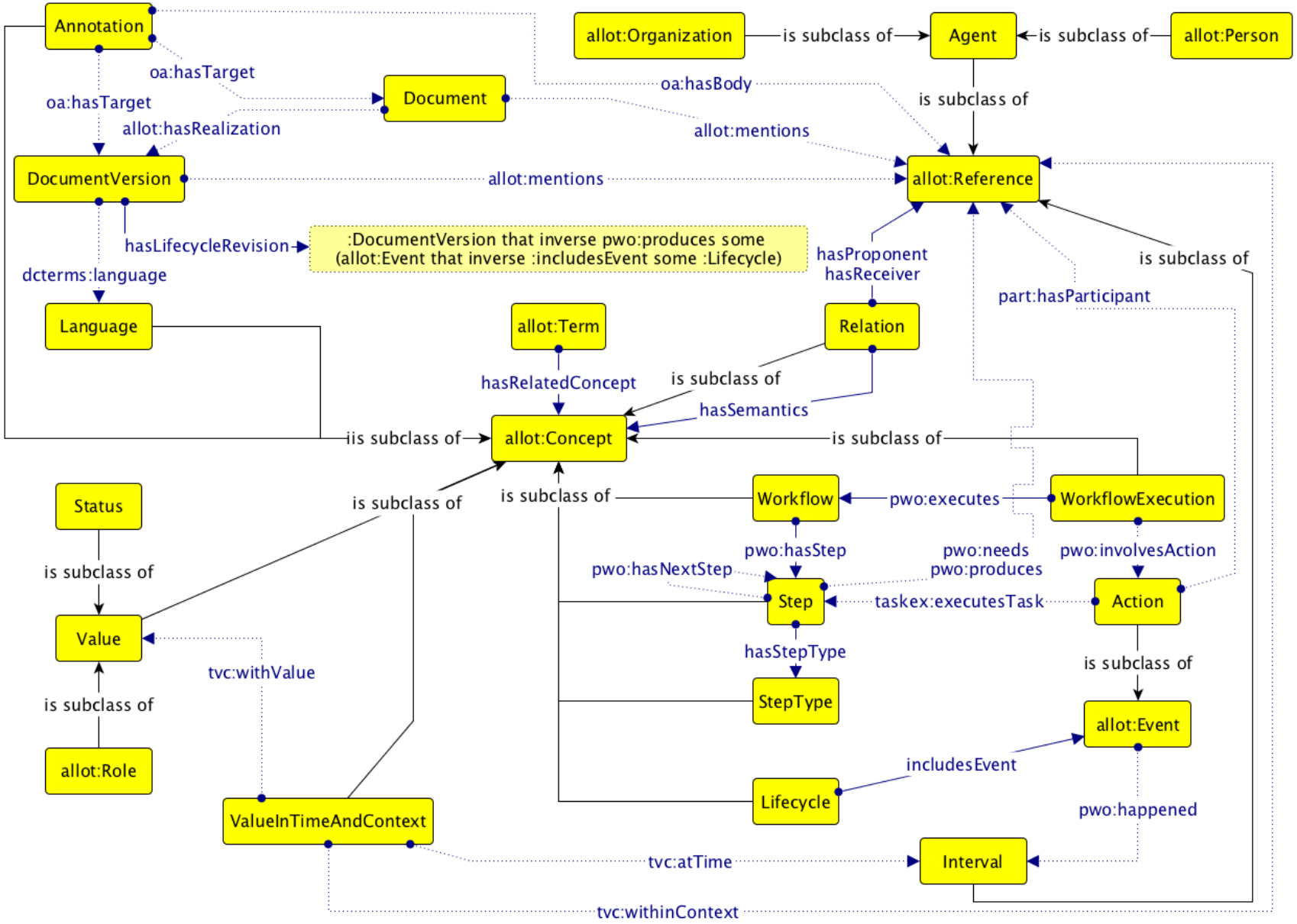
Fig. 8. Generalization level by engineering approaches.

Legal core ontology

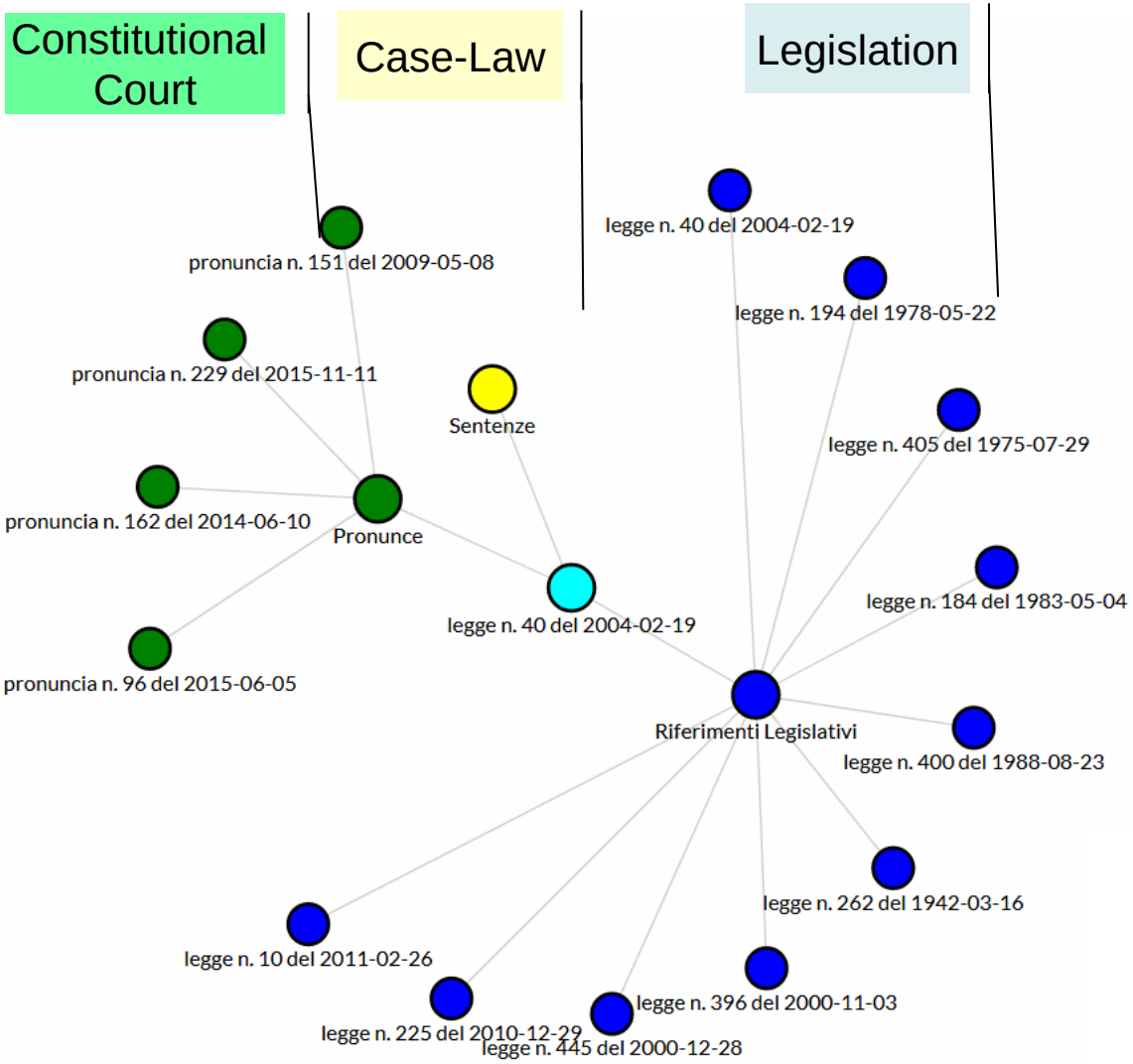
lkif core



UNDO- United Nations Document Ontology



Integration of multiple legal sources



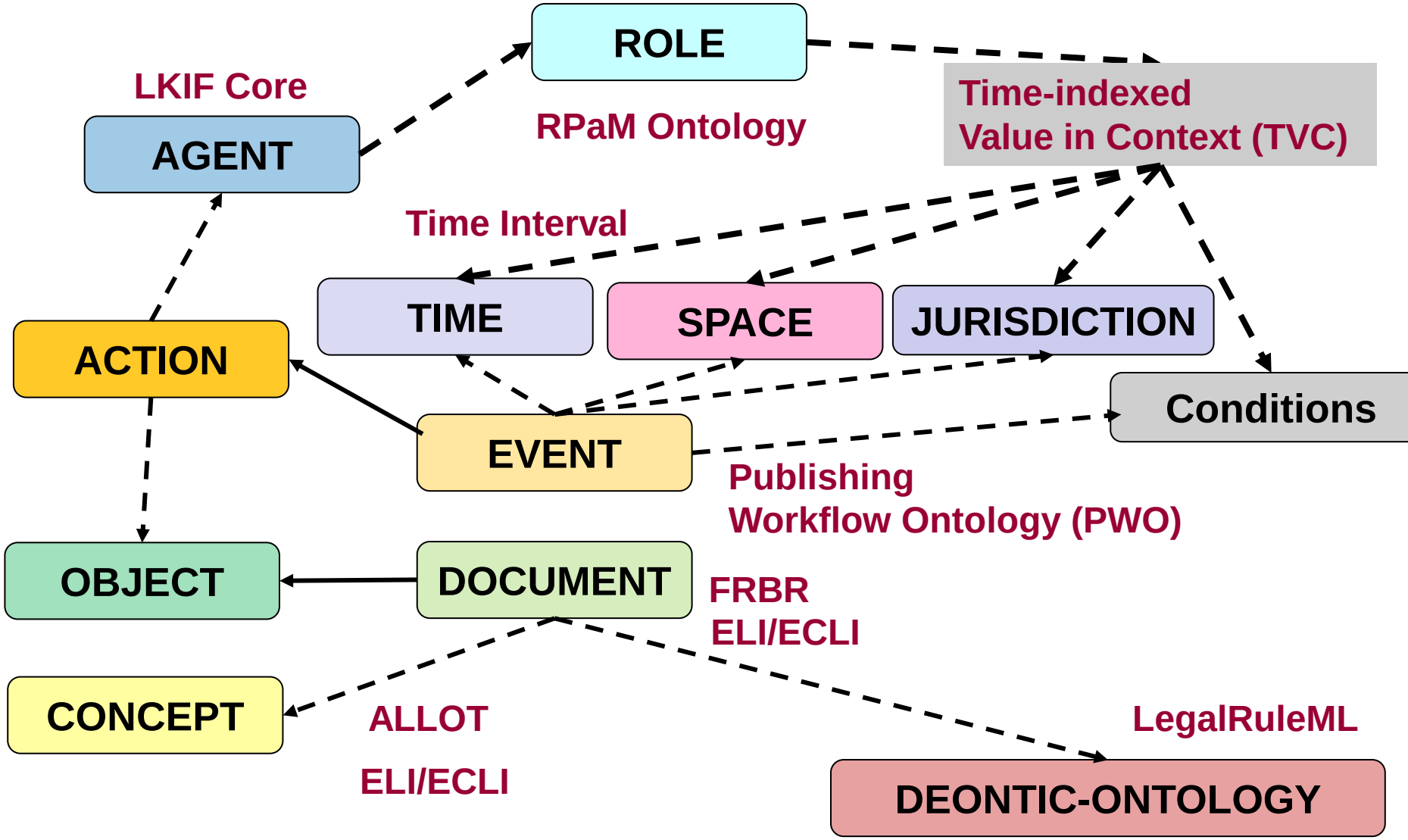
EUR-Lex

CVRIA

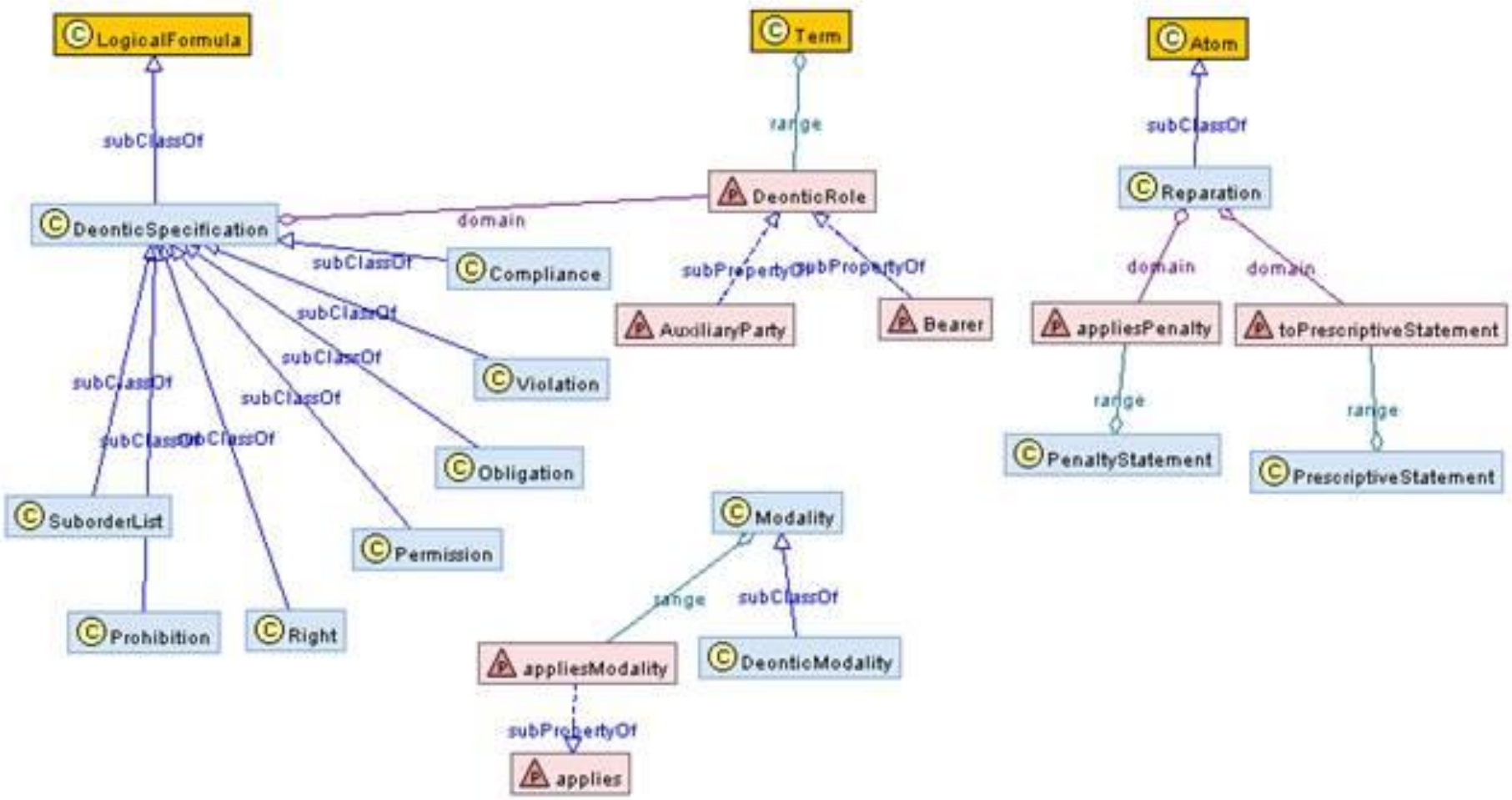
EUROPEAN COURT OF HUMAN RIGHTS

COUR EUROPÉENNE DES DROITS DE L'HOMME

Ontology Design Patterns for Legal Domain



LegalRuleML: Legal deontic ontology



METHODOLOGY

MelOn methodology

Dolce

lkif core

FRBR

1. Describe the goal of the ontology (storytelling)
2. Evaluation indicators and parameters/indicators to evaluate the ontology
3. State of the art survey and other existing domain vocabularies
4. List all the relevant terminology and produce a glossary
5. Use tables to model the knowledge-base of the legal domain (excel)
6. Contingency questions
7. Transform the tables in UML model using the Graffo tool
8. Transform the UML into OWL/XML serialization
9. Test the output under the technical and legal point of view (SPARQL queris on individuals)
10. Refine and optimize OWL by ontologist experts
11. Evaluate the ontology using the OntoClean method and goto 2)
12. Publish the document with the LODE tool and github
13. Collect feedbacks from the community (Validation)

Methodology of Hybrid AI

- 1. start to the context (terms/taxonomy) with legal experts (e.g., MeLOn)
- 2. use NLP for discovering relevant portions of the text (regEx/POS/NER/NLP/AI)
- 3. identify the main relationships between concepts (ontology/ML/DL)
- 4. detection of the fine-fragments in the text (ML/LLM)
- 5. modelling rules in logic (symbolic/deontic)
- 6. represent in LegalRuleML
- 7. check the consistency (legal reasoner)
- 8. training again the AI model
- 9 testing, evaluating, validating

PRIVACY REGULATION AND PRIVACY POLICY

PrOnto ontology of GDPR

Data

hasProcessing

hasLegalBasis

Purposes

hasPurpose

Processing

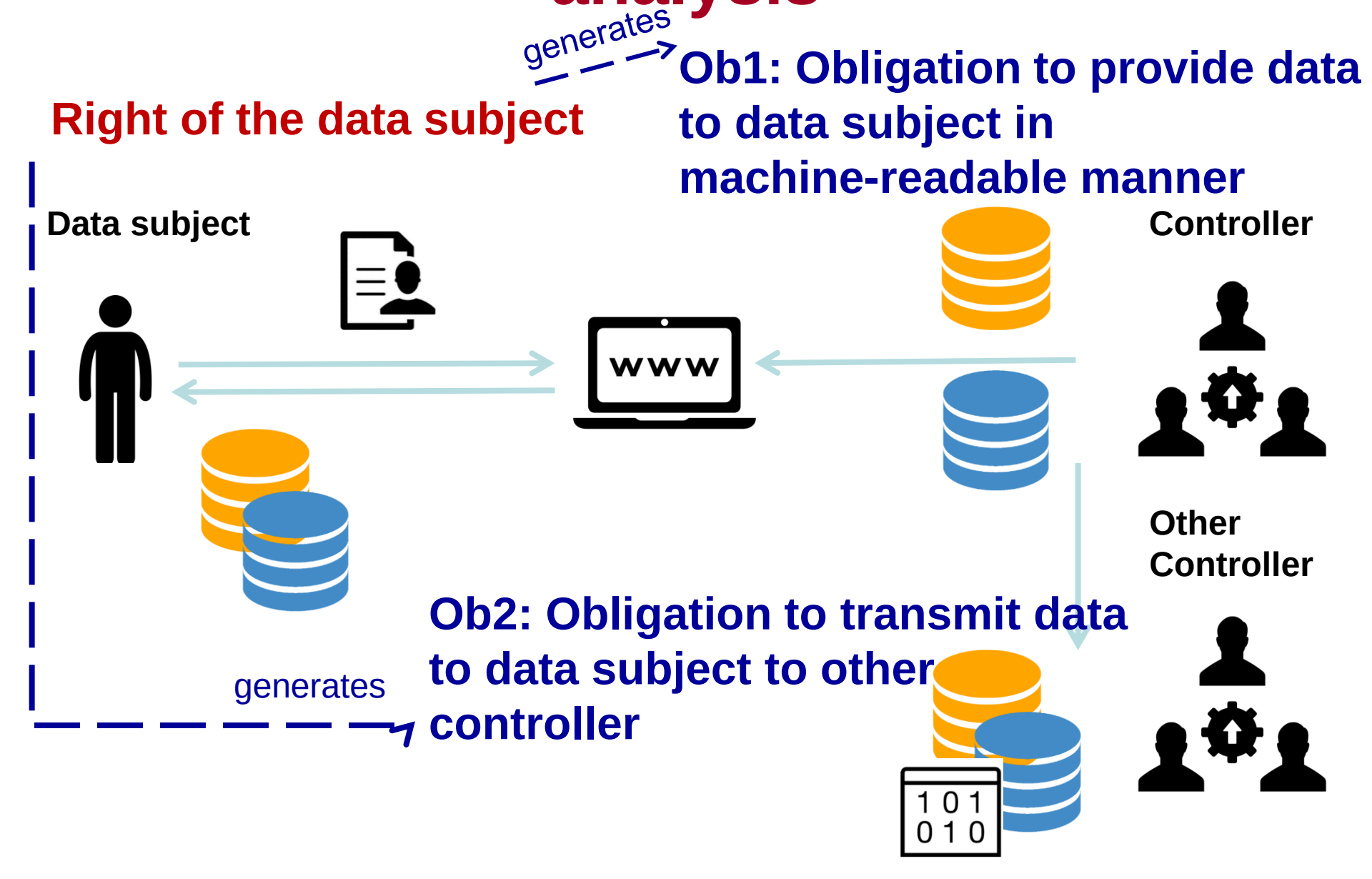
Agents

isActedBy

Rights/Obligations

hasRights
hasObligations

Right to data portability: legal analysis



Text: Art. 20 GDPR
Right of portability of data

"1. The data subject shall have the **right to receive the personal data concerning him or her, which he or she has provided to a controller, in a structured, commonly used and machine-readable format** and have **the right to transmit those data to another controller without hindrance from the controller to which the personal data have been provided**, where: R1 R2

(a) the processing is based on consent pursuant to point (a) of Article 6(1) or point (a) of Article 9(2) or on a contract pursuant to point (b) of Article 6(1); and

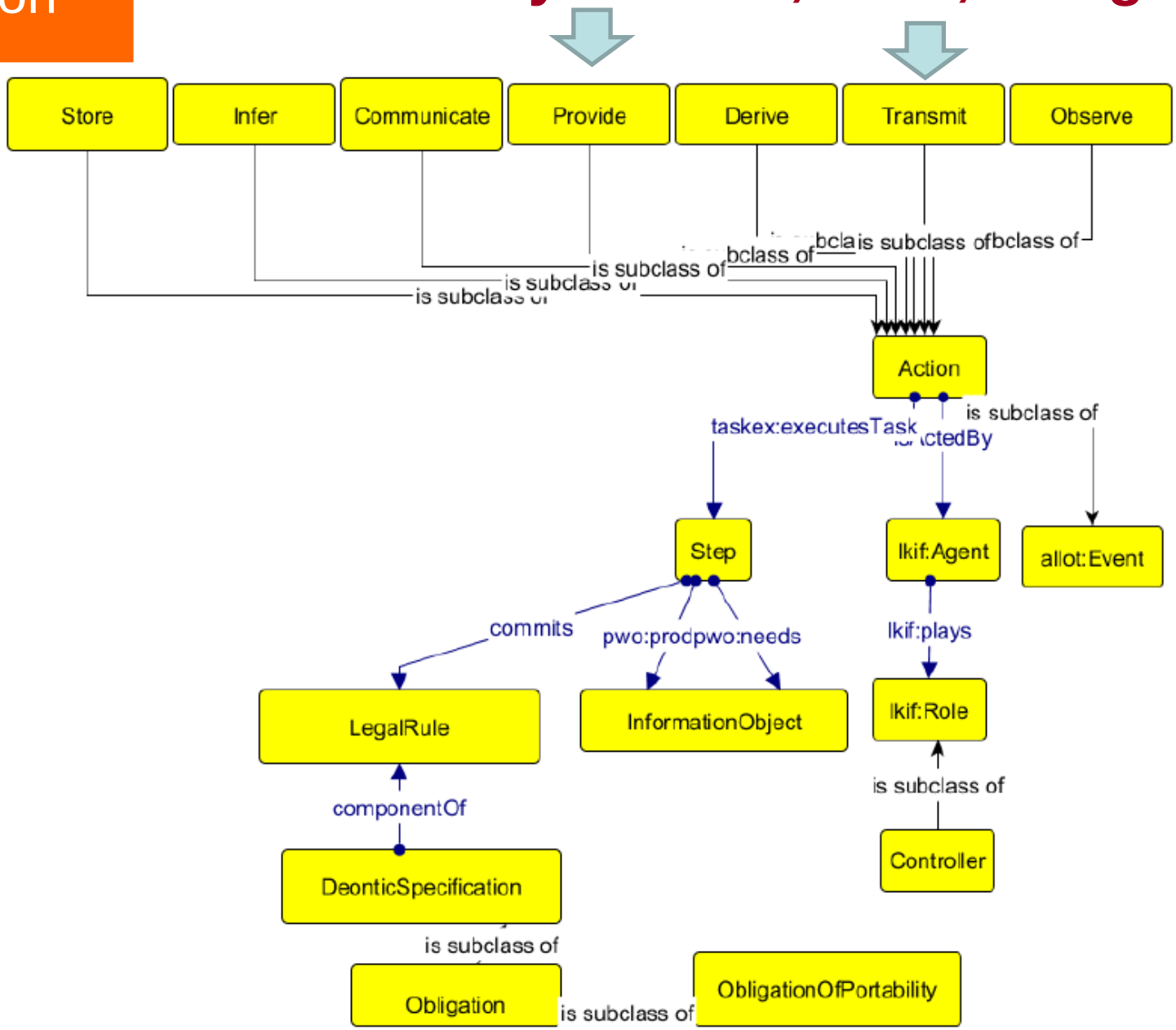
(b) the processing is carried out by automated means."

Text : Art. 20 GDPR
Right of portability of data

- “ 2. In exercising his or her right to data portability pursuant to paragraph 1, the data subject shall have the right to have the personal data transmitted directly from one controller to another, where technically feasible. **Specification of R2**
- 3. The exercise of the right referred to in paragraph 1 of this Article shall be without prejudice to Article 17. That right shall not apply to processing necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller. **Exception- R1 and R2**
- 4. The right referred to in paragraph 1 shall not adversely affect the rights and freedoms of others.” **Specification of R1 and R2**

Rights/ Obligations

Concepts: The Right to Data Portability: Action, Rule, Obligation



Rights/ Obligations

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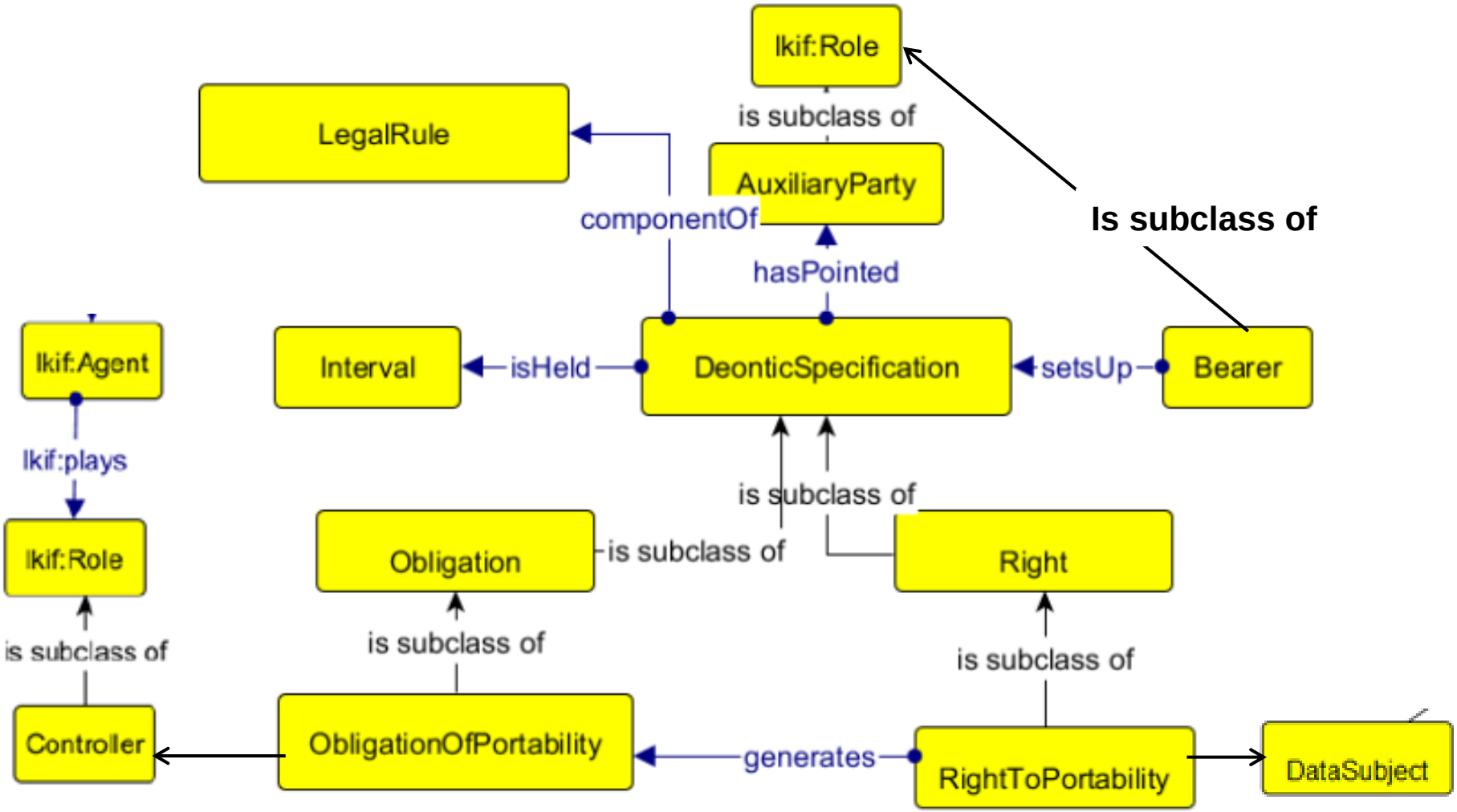

Detection of fragments: Art. 20 GDPR
Right of portability of data

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Modelling Rules: Art. 20 GDPR
Right of portability of data

Legal Text

«The data subject shall have the **right to receive the personal data concerning him or her, which he or she has provided to a controller, in a structured, commonly used and machine-readable format** »

Logic rule

IF

datasubject(X) ∧ personalData(D) ∧ controller(Y) ∧ legalBasis (consent or contract) ∧ automatedProcess(D)

THEN

obligation_to_provide_in_mrf(Y,D, X)

Exceptions

Art. 8 GDPR admits being trumped by domestic regulation

«Member States may provide by law for a lower age for those purposes provided that such lower age is not below 13 years.»

At present in Europe different age limitations are in place (e.g, age 13 in Spain; 14 in Italy; 11 15 in France). LegalRuleML makes it possible to use defeasible operators

<lrml:appliesStrength iri="lrmlv:Defeasible"/>

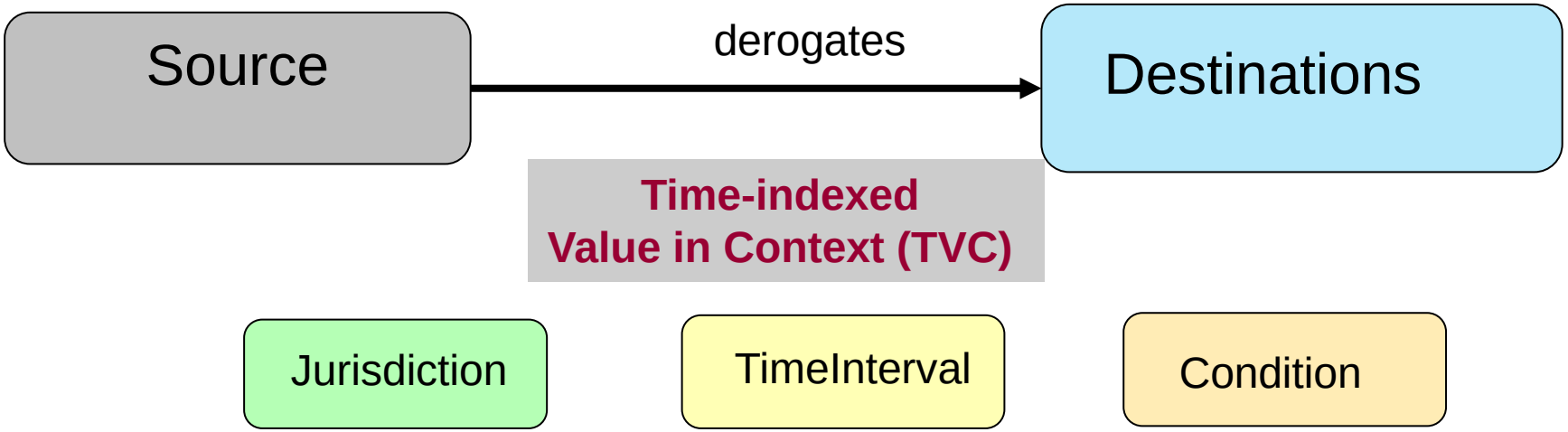
And defyning jurisdiction

<lrml:appliesJurisdiction keyref="jurisdictions:it"/>

DEROGATION

Anatomy of a derogation

$R1_{t1}$ derogated to $R2_{t2}$



By way of derogation from paragraphs 1 and 2, in Cyprus, Croatia, Malta and Slovenia, the amount referred to in those paragraphs may be set at a value lower than EUR 500, but not less than EUR 200 or, in the case of Malta, not less than EUR 50.

Dataset

- The dataset is composed by legislative act in the span of time 2010-2020 for a total of 15.328 documents.
- Regulation, Directive, Implementation instruments
- The documents are converted in Akoma Ntoso in order to have the structure of the document and the context annotated
- We have extracted 13.587 partitions involved in the derogation using a preliminary taxonomy of “RegEx”
- Then using Tree Kernel/ supervisioned ML

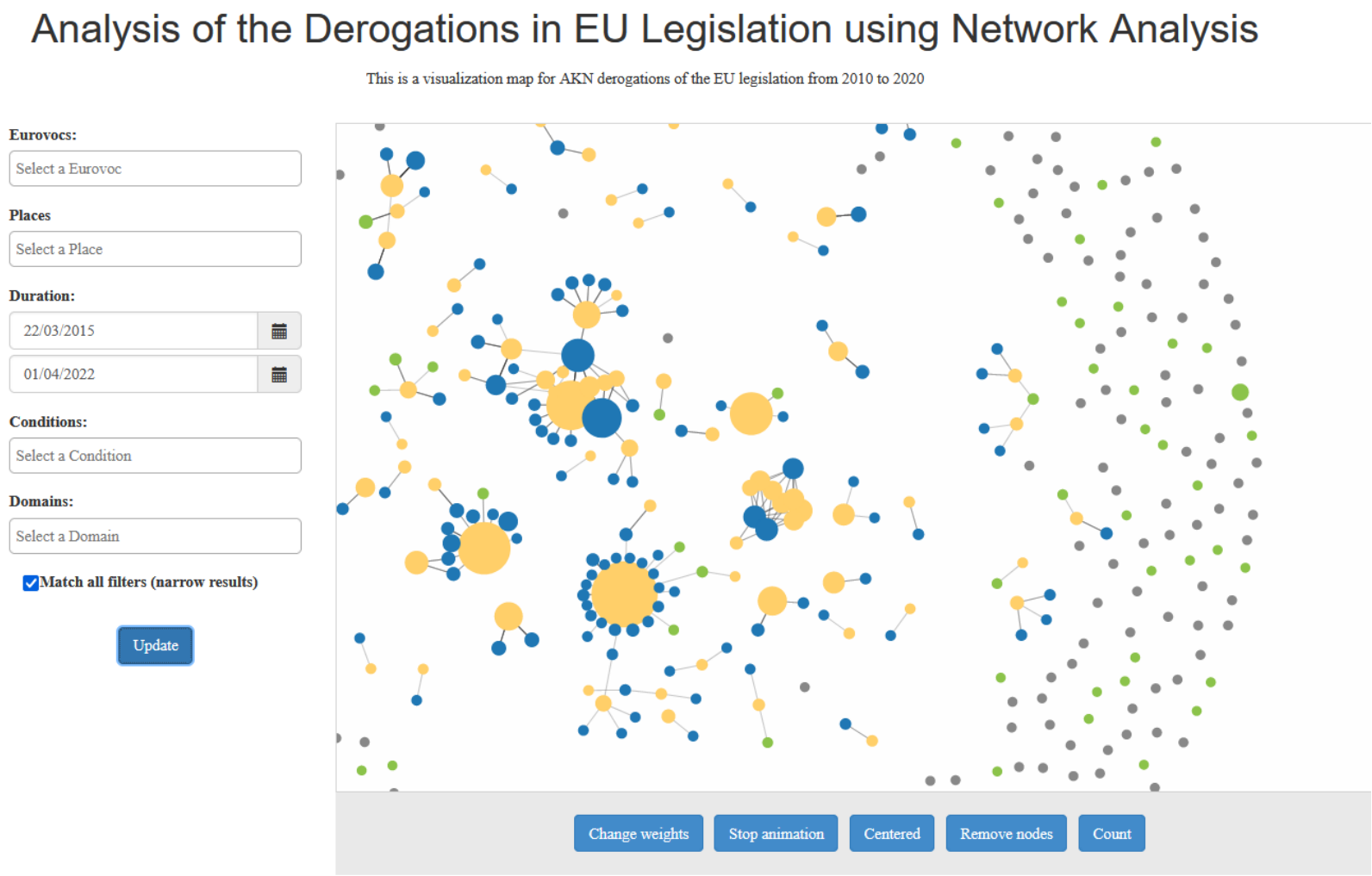
Akoma Ntoso: detection of knowledge

```
<alinea eId="body__art_2__al_3">
        <content eId="body__art_2__al_3__content">
            <mod eId="body__art_2__al_3__content__mod_1">
                <p>By way of derogation from the second paragraph,
Member States may choose not to apply the provisions of point
ORO.FTL.205(e) of
                <ref eId="ref_1"
href="href="/akn/eu/act/regulation/2012-02-17/965-
2012/!main/>annex_III">Annex III to Regulation (EU) No 965/2012 </ref>
and continue to apply the existing national provisions concerning in-flight
rest until
<date date="2017-02-17" refersTo="#derogationTime">17 February
2017</date>.</p>
            </mod>
        </content>
 </alinea>
```

Legal Knolwedge extraction and Akoma Ntoso serialization

```
<scopeMod type="exceptionOfScope">
                <source href="body__art_2__al_3__content__mod_1"/>
                <destination
                   href="/akn/eu/act/regulation/2012-02-17/965-
2012/!main/annex_III"/>
                <force>
                   <date date="2014-02-20"/>
                </force>
                <duration>
                   <date date="2017-02-17" refersTo="#endDate"/>
                </duration>
                <condition/>
                <domain/>
</scopeMod>
```

https://cirsfid.gitlab.io/derograph/



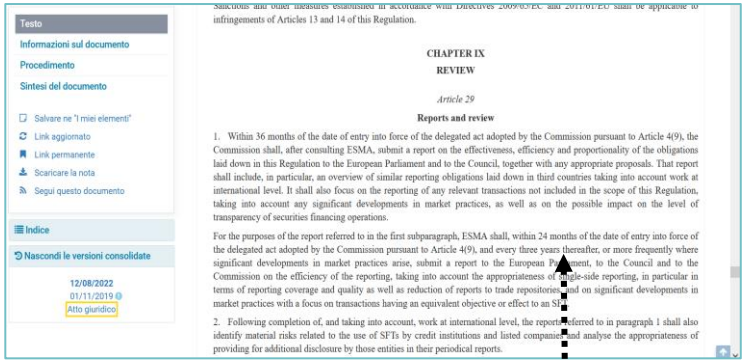
$$w = k * (\#ActiveDerogations + \#ReflexiveDerogations + \#PassiveDerogations)$$

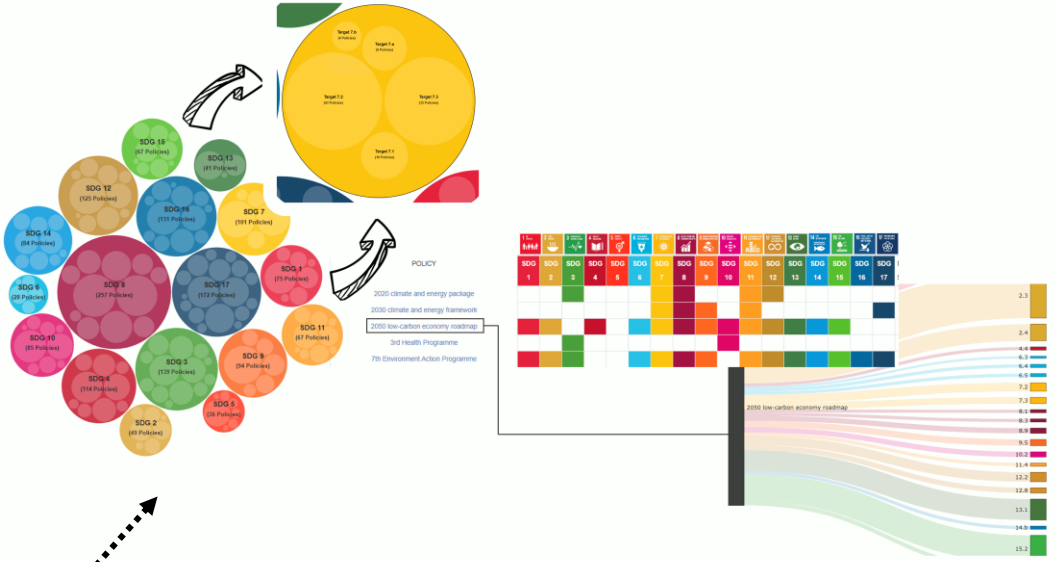
DECISIONS

Measuring the Policy

AKOMA NTOSO

Architecture for Knowledge-Oriented Management of African Normative Texts using Open Standards and Ontologies





Obbligations

Policy

LegalRuleML

Legal Text

Machine-readable metadata

Integration

Regulation (EU) 2016/1011 on indices used as benchmarks in financial instruments and financial contracts

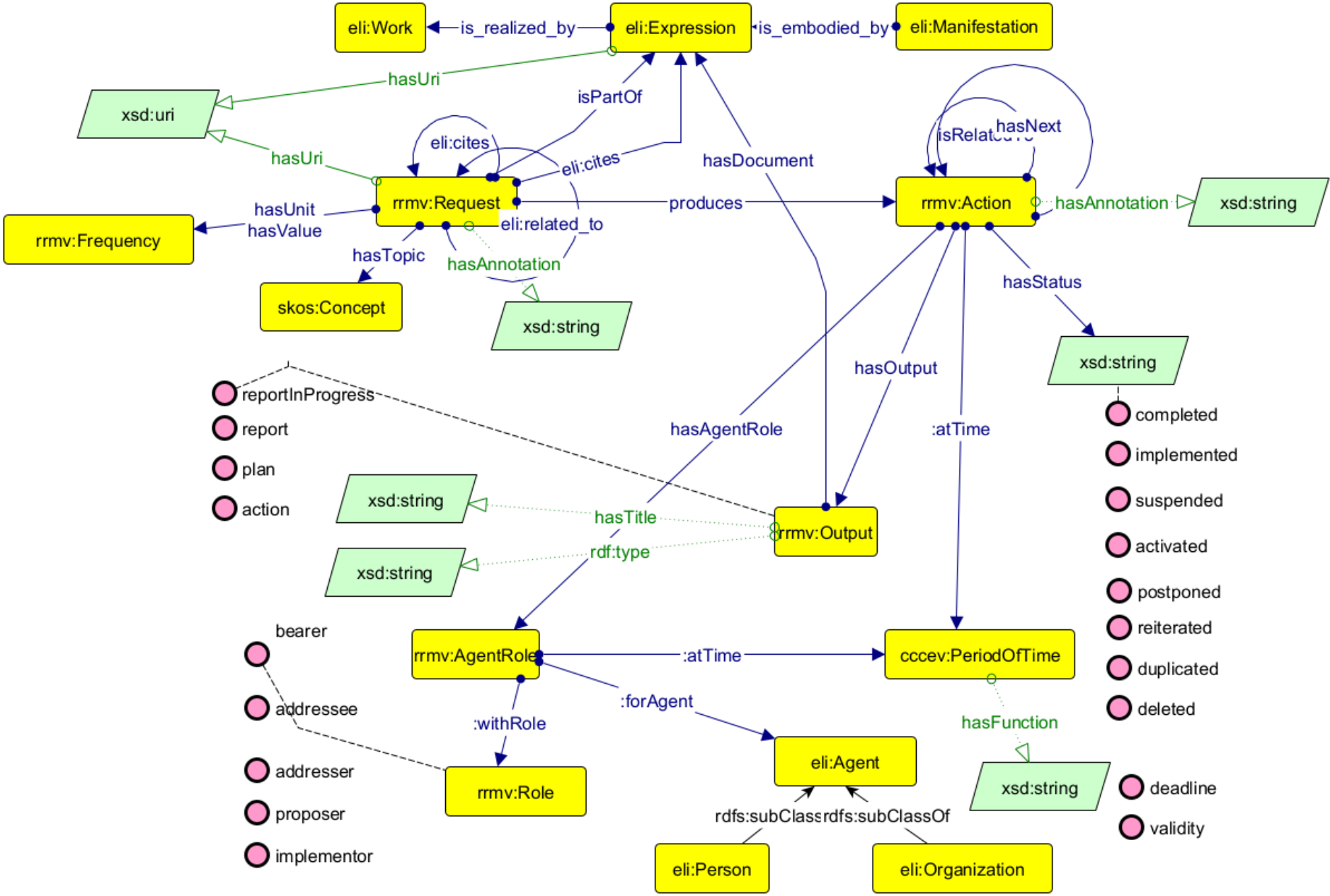
Art. 54

2. Review the evolution of international principles applicable to benchmarks and of legal frameworks and supervisory practices in third countries concerning the provision of benchmarks and report to the European Parliament and to the Council every five years after 1 January 2018. That report shall assess in particular whether there is a need to amend this Regulation and shall be accompanied by a legislative proposal, if appropriate.

Reports

2023 2028 2033 etc.

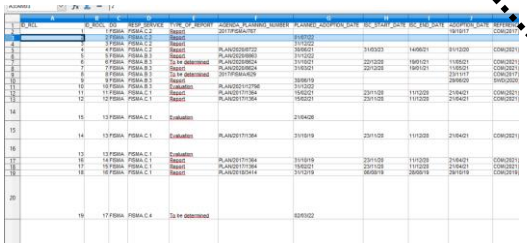
Request modelling



Managing the decisions and the policies

ROD

KOEL



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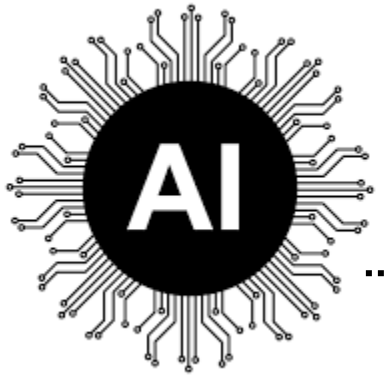

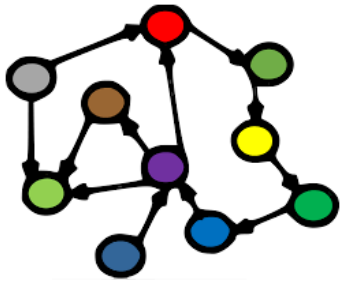

Classification
Extraction

Training

Annotated information

Baseline

New Law

Conclusions

Legal ontology level is good for:

1. Methodology for analysing a legal domain in formal way
2. Discover hidden/implicit legal knowledge that only the experts known
3. Formalize the legal concepts and their relationships
4. Support AI dataset annotation and training
5. Provide “ingredients” for the XAI – explicable AI
6. Support the Legal Rule modelling using stable predicates and constitutive axioms (definitions)

Hybrid AI for Legal Domain

Thanks for your attention

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