Tutorial - Part IV

Applications

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Licenses in the Web of Data

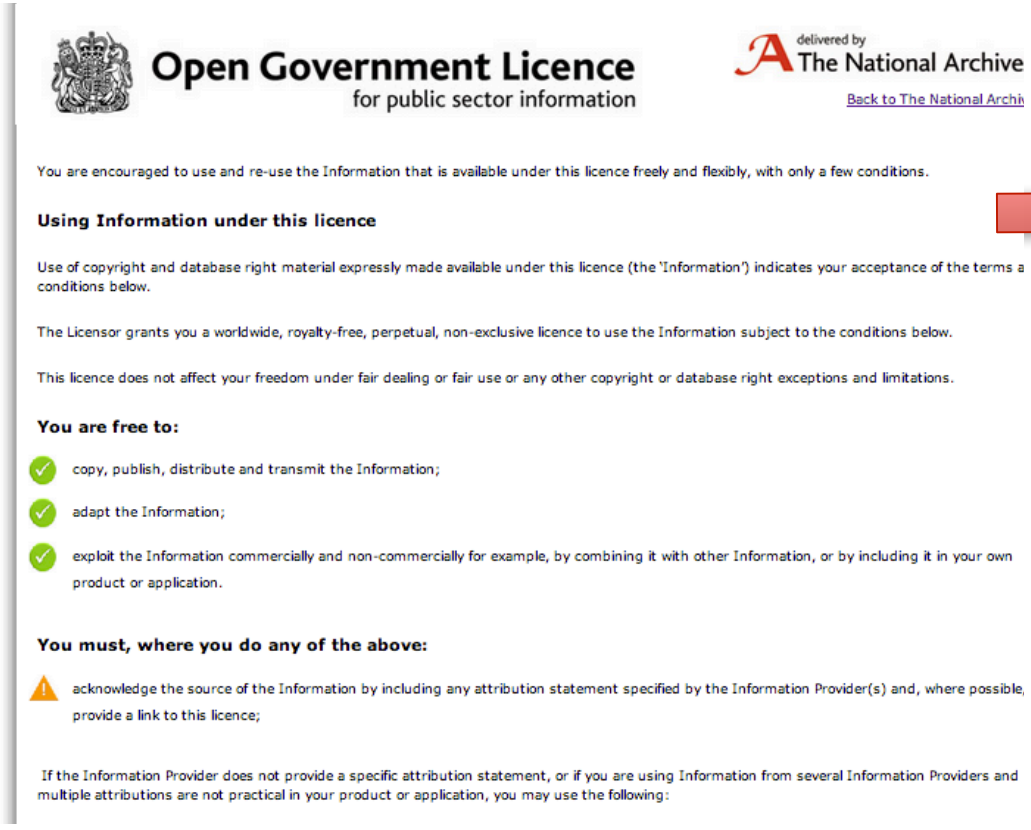
"the absence of clarity for data consumers about the terms under which they can reuse a particular dataset, and the absence of common guidelines for ***data licensing****, are likely to* ***hinder use and reuse of data****"*

Heath and Bizer,
Linked Data: Evolving the Web into
a Global Data Space, 2011

Licenses in the Web of Data

- Support for generating RDF licenses
- Share-Alike statements
- Licenses compatibility and composition
- Open challenges

Support for generating RDF licenses



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If the Information Provider does not provide a specific attribution statement, or if you are using Information from several Information Providers and multiple attributions are not practical in your product or application, you may use the following:

```
@prefix odrl: http://www.w3.org/ns/odrl/2/.
@prefix l4lod: http://ns.inria.fr/l4lod/.
@prefix : http://example/licenses/.

:licOGL a odrl:Set;
        odrl:permission [
                a odrl:Permission;
                odrl:action odrl:distribute;
                odrl:action odrl:derive;
                odrl:action odrl:commercialize
        ] ;
        odrl:duty [
            a odrl:Duty;
                odrl:action odrl:attribute;
        odrl:action odrl:attachPolicy
        ] .
```

RESEARCH QUESTION

How to **support users** in defining RDF licenses from natural language ones?

Main features

1. RDF representation of licenses - **CCRel and ODRL vocabularies**,
2. Classification problem in supervised learning - **Support Vector Machines**,
3. Online service: NLL2RDF
   (Natural Language License to RDF)

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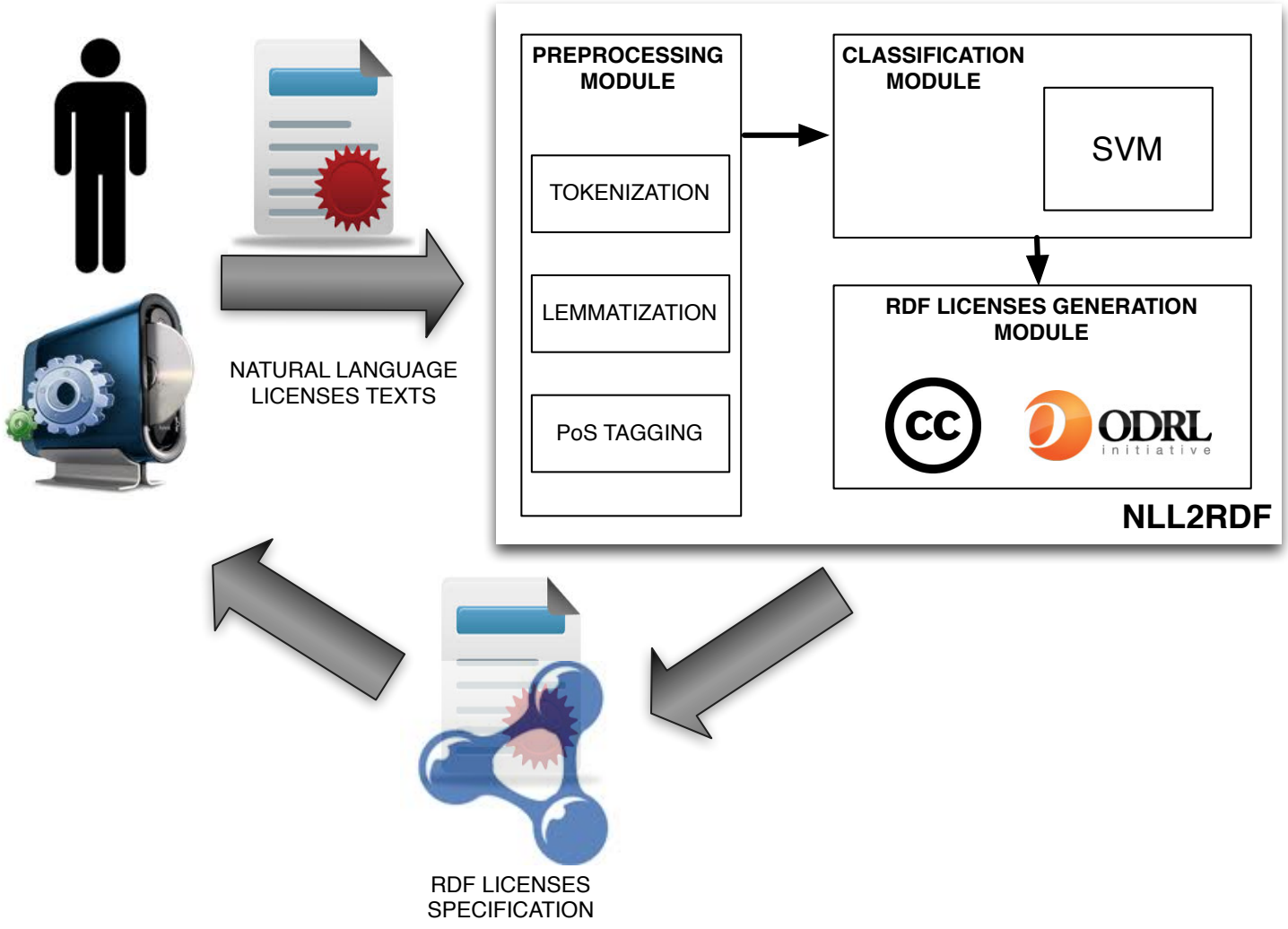
Synopsis of the overall framework



NLL2RDF - online demo

Test it!

`http://www.airpedia.org/nll2rdf-tool/`

Share-Alike statements

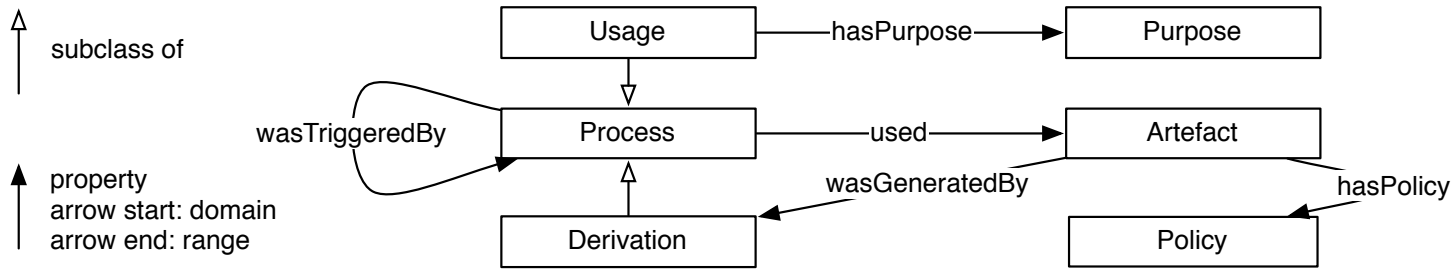
Goal:

- model licenses as **part of the data** to enable easy **exchange** and **automated processing**

Solution:

- new **policy modelling language** to manage Share-Alike statements

Model of provenance information



Modeling licenses in OWL DL

Public Domain License

- $PD : Usage \sqcup Derivation.$

CC Attribution

- $BY : (Usage \sqcap \exists wasTriggeredBy.Attribution) \sqcup (Derivation \sqcap \forall wasGeneratedBy^{-1}.\forall hasPolicy.\exists containedIn.\{BY\}).$

Modeling licenses in OWL DL

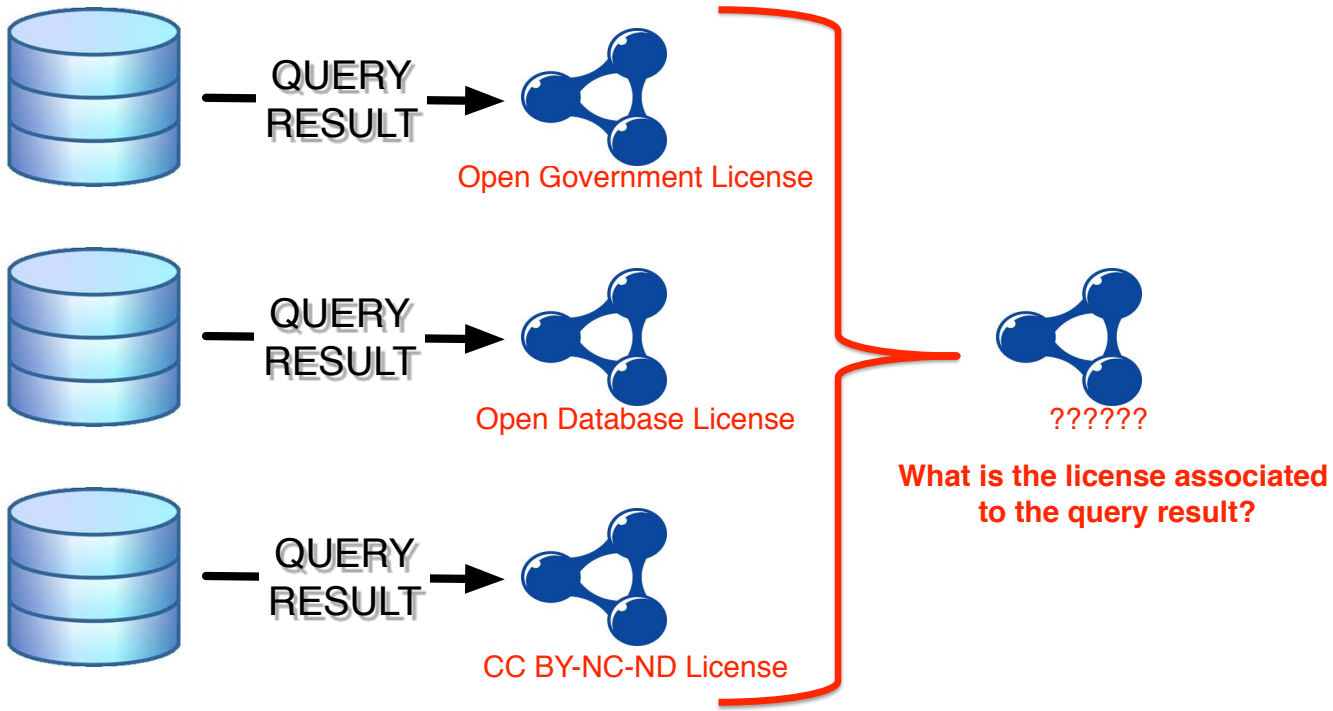
CC Attribution-NoDerivs

- $BY - ND : C_{BY} \sqcap C_{ND}$.

CC Share-Alike

- $BY - SA : C_{BY} \sqcap \forall wasGeneratedBy^{-1}.\forall hasPolicy.(\exists containedIn.\{BY - SA\} \sqcap \exists containedIn^{-1}.\{BY - SA\})$.

Licenses compatibility and composition



RESEARCH QUESTIONS

1. How to compose in a **compliant** way the licensing terms to produce a single **composite license**?
2. How to produce in an **automated** way the composite license adopting different **composition heuristics**?

Main features

1. Combination of **Semantic Web languages** (machine-readable licenses) - **defeasible deontic logic**,
2. Extension of existing proposals for licenses compatibility and composition in **service license analysis and CC licenses**,
3. **Heuristics** for licenses combination.

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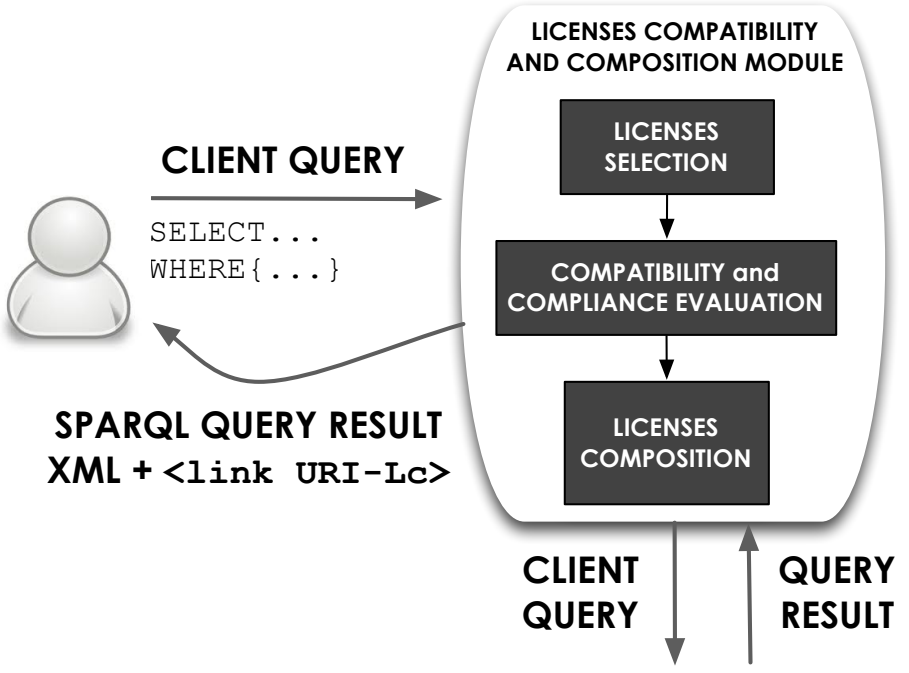

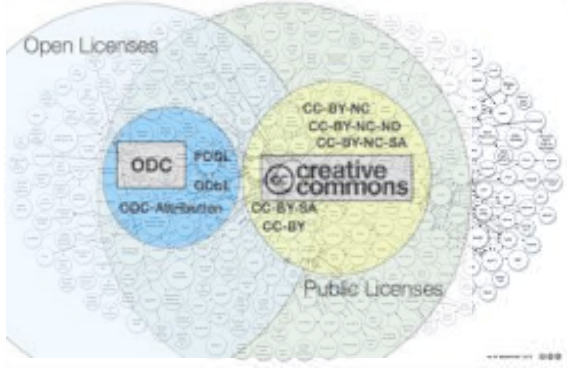

The formal language

Represent, and reason about two components:

1. describe ontology of concepts involved in LOD licenses,
2. capture the deontic component of those licenses.

- Rule-based language,
- **Ontology rules**:
  regular defeasible logic rules for deriving plain literals,
- $a_1, \ldots, a_n \Rightarrow_c^{l_1} b$ support the conclusion of b, given $a_1, \ldots, a_n$,
- **Logic of deontic rules**:
  constructive account of basic deontic modalities (obligation, prohibition, permission),
- $a, \mathrm{O}b \Rightarrow_{\mathrm{O}}^{l_2} p$: if a is the case and b is obligatory, then $\mathrm{O}p$ holds in license l_2.

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Composition heuristics

- **OR-composition:** if *at least one* of the licenses involved in the composition owns a clause, then also l_c owns it;
- **AND-composition:** if *all* the licenses involved in the composition own a clause, then also l_c owns it;

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Proof theory

- Combining licenses,
- Checking their compatibility,
- Establishing ontology and deontic conclusions which can be drawn from the composite license,

  i.e., if $l_c = l_1 \odot \cdots \odot l_n$ obtained from $l_1, \ldots, l_n$ then conclusions derived in the logic are those that hold in the perspective of l_c.

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Positive definite provability $\rightarrow$ in the paper

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Proof theory: Positive defeasible provability

Defeasible provability ($+\partial^{M^l c} p$):

- $M^l p$ is a fact; or
- there is an applicable strict or defeasible rule r in R^x for $M^l p$ and, for every rule s in R^y for $M^{l'} \sim p$, either
  - s discarded or
  - r is weaker than an applicable strict or defeasible rule t in R^x for $M^{l''} p$.

OR-composition: $R^x = R^y$ is the union set of all rules of all licenses in the composition

AND-composition: R^x consists of all rules shared by all licenses in the composition and R^y is the union set of all rules of all licenses in the composition.

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Example: l_1 and l_2 composition

$$L = \{l_1, l_2\}$$

$$R^{\mathrm{O}^{l_1}} = \{r_1 :\Rightarrow^{l_1}_{\mathrm{O}} \textit{Attribution}, \quad r_2 :\rightsquigarrow^{l_1}_{\mathrm{O}} \textit{Commercial}\}$$

$$R^{\mathrm{O}^{l_2}} = \{r_3 :\Rightarrow^{l_2}_{\mathrm{O}} \sim\textit{Commercial}, \quad r_4 :\Rightarrow^{l_2}_{\mathrm{O}} \textit{ShareAlike}, \quad r_5 :\rightsquigarrow^{l_2}_{\mathrm{O}} \textit{Derivative}\}$$

OR heuristics for obligations
AND heuristics for permissions

$+\partial^{\mathrm{O}^{l_c}}$ *Attribution*, $+\partial^{\mathrm{O}^{l_c}}$ *ShareAlike*, and $+\partial^{\mathrm{P}^{l_c}}$ *Derivative*

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Evaluation: SPINDle (logic defeasible reasoner)

http://spin.nicta.org.au/spindle/

Real life example from the logic to SPINdle

$$F = \{Open\}$$

$$L = \{l_{OGL}, l_{ODbL}, l_{BY-NC-ND}\}$$

$$R^{O^{l_{OGL}}} = \{r_1 :\Rightarrow^{l_{OGL}}_{O} Attribution,\ r_2 : Open \rightsquigarrow^{l_{OGL}}_{O} Publishing,\ r_3 : Open \rightsquigarrow^{l_{OGL}}_{O} Distribution,\ r_4 : Open \rightsquigarrow^{l_{OGL}}_{O} Derivative,\ r_5 : Open \rightsquigarrow^{l_{OGL}}_{O} Commercial\}$$

$$R^{O^{l_{ODbL}}} = \{r_6 :\Rightarrow^{l_{ODbL}}_{O} ShareAlike,\ r_7 :\Rightarrow^{l_{ODbL}}_{O} Attribution,\ r_8 :\rightsquigarrow^{l_{ODbL}}_{O} Sharing,\ r_9 :\rightsquigarrow^{l_{ODbL}}_{O} Derivative\}$$

$$R^{O^{l_{BY-NC-ND}}} = \{r_{10} :\Rightarrow^{l_{BY-NC-ND}}_{O} Attribution,\ r_{11} :\Rightarrow^{l_{BY-NC-ND}}_{O} \sim Commercial,\ r_{12} :\Rightarrow^{l_{BY-NC-ND}}_{O} \sim Derivative,\ r_{13} :\rightsquigarrow^{l_{BY-NC-ND}}_{O} Sharing\}$$

$$\succ = \{l_{ODbL} \succ l_{BY-NC-ND}\}$$

Real life example
from the logic to SPINdle

```
>> Open
r1: =>[Oc]Attribution
r2: Open =>[-Oc] -Publishing
r3: Open =>[-Oc] -Distribution
r4: Open =>[-Oc] -Derivative
r5: Open =>[-Oc] -CommercialExpl

r6: =>[Oc] ShareAlike
r7: =>[Oc] Attribution
```

```
r8: =>[-Oc] -Share
r9: =>[-Oc] -Derivative

r10: =>[Oc] Attribution
r11: =>[Oc] -CommercialExpl
r12: =>[Oc] -Derivative
r13: =>[-Oc] -Share

r9 > r12
```

Real life example from SPINdle to RDF

AND-composition $+\partial^{\mathrm{O}^{lc}}$ *Attribution*

OR-composition is admissible: conflict between r_5 and r_{11}, and between rule r_{12} and rules r_4 and r_9

Deontic conclusions: $+\partial^{\mathrm{O}^{lc}}$ *Attribution*, $+\partial^{\mathrm{O}^{lc}}$ *ShareAlike*, $+\partial^{\mathrm{P}^{lc}}$ *Publishing*, $+\partial^{\mathrm{P}^{lc}}$ *Distribution*, $+\partial^{\mathrm{P}^{lc}}$ *Sharing*, $-\partial^{\mathrm{P}^{lc}}$ *Derivative*, $-\partial^{\mathrm{P}^{lc}}$ *Commercial*

SPINdle it takes **14 milliseconds** to produce the following conclusions

```
+d [Oc]Attribution,
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2. Data obtained by **inference** from one or several licensed datasets, i.e., queries going beyond basic `SELECT` queries, where **aggregations** are present, e.g., *average*, *sum*
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Thanks for your attention!