Linking and Negotiating Uncertainty Theories over Linked Data

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:Paper :isPresentedBy ?x

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- Web-Instrumented Man-Machine Interactions, Communities & Semantics
  : AI in bridging social semantics and formal semantics on the Web

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  - Fabien Gandon

Outline

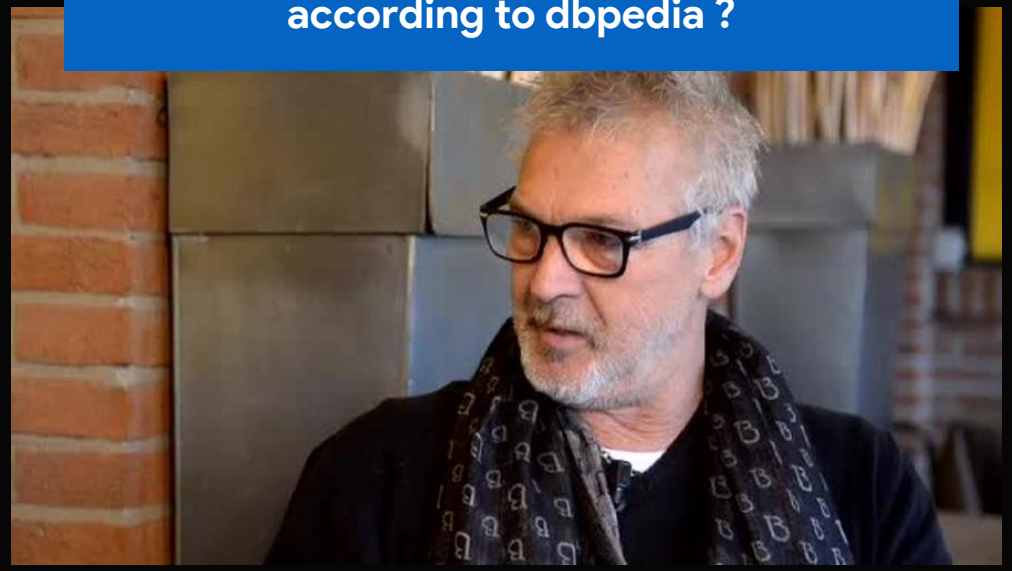
- Introduction
- Uncertainty Representation
- Translating & Negotiating Uncertainty
- Perspectives
- Conclusion

« It’s too easy for misinformation to spread on the web »

- Tim Berners-Lee, 2017 *

*** https://webfoundation.org/2017/03/web-turns-28-letter/**

What is the height of Stefano Tacconi, according to dbpedia ?



Credits: Google images

Metadata

15

```
select ?x where {
	<http://dbpedia.org/resource/Stefano_Tacconi> <http://dbpedia.org/ontology/height> ?x
}
```

1.88 m - **en.dbpedia**

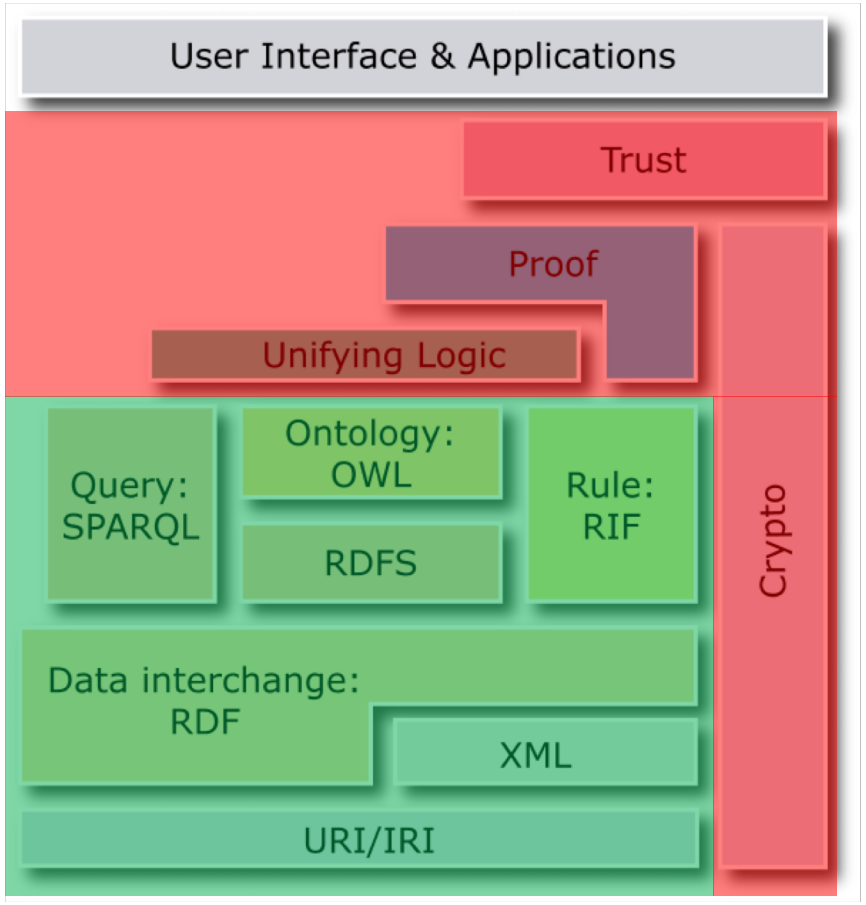
1.93 m - **fr.dbpedia**

192 cm - **pl.dbpedia**

188 cm - **it.dbpedia**

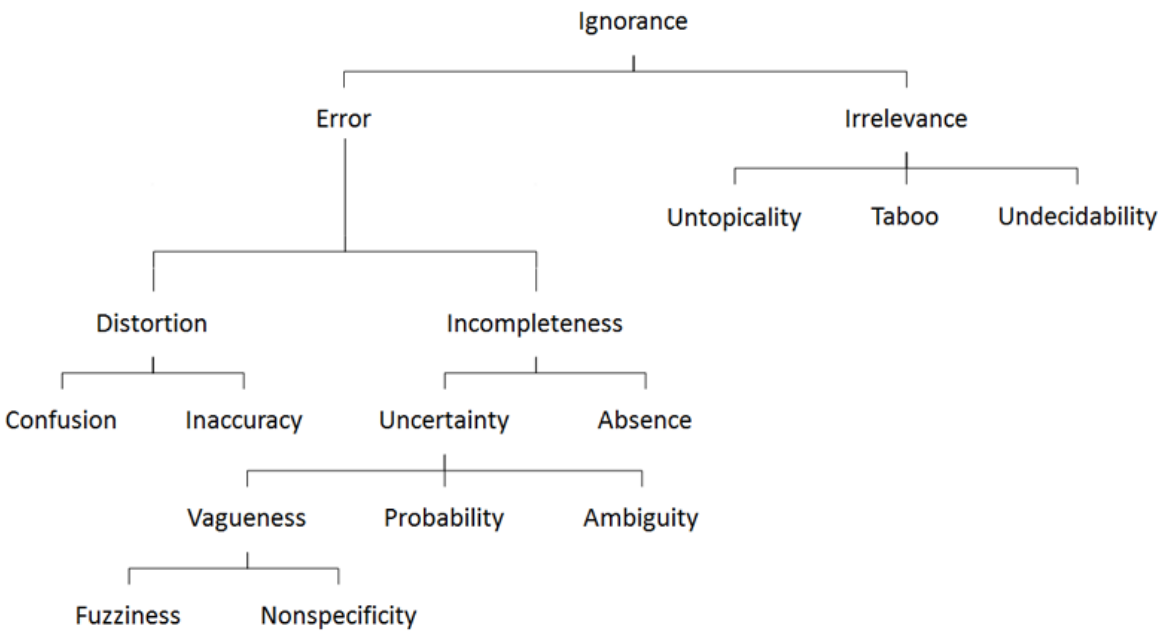
Introduction

- Invalidity
- Incompleteness
- Inconsistentcy
- **Undecidability**
- Context ignorance
- Bias, Subjectivity
- Etc.



Uncertainty Representation

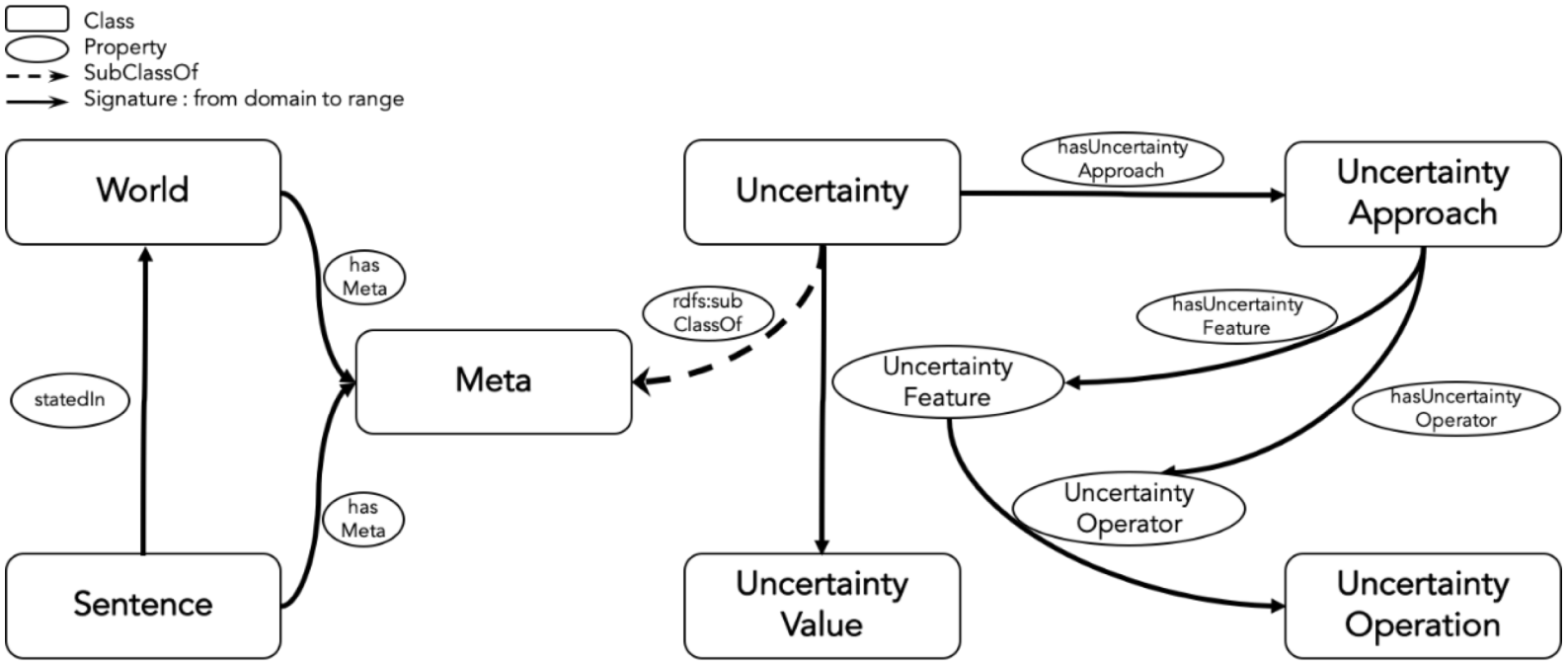
- It's **metadata**, yet still, **data**
- Indicates **ignorance**
- Linked to **undecidability**
- Follows a **theory** (Approach)



Smithson, M. (2012). *Ignorance and uncertainty: emerging paradigms.* Springer Science & Business Media.

Uncertainty Representation

mUnc Vocabulary*



* ns.inria.fr/munc/

Uncertainty Representation

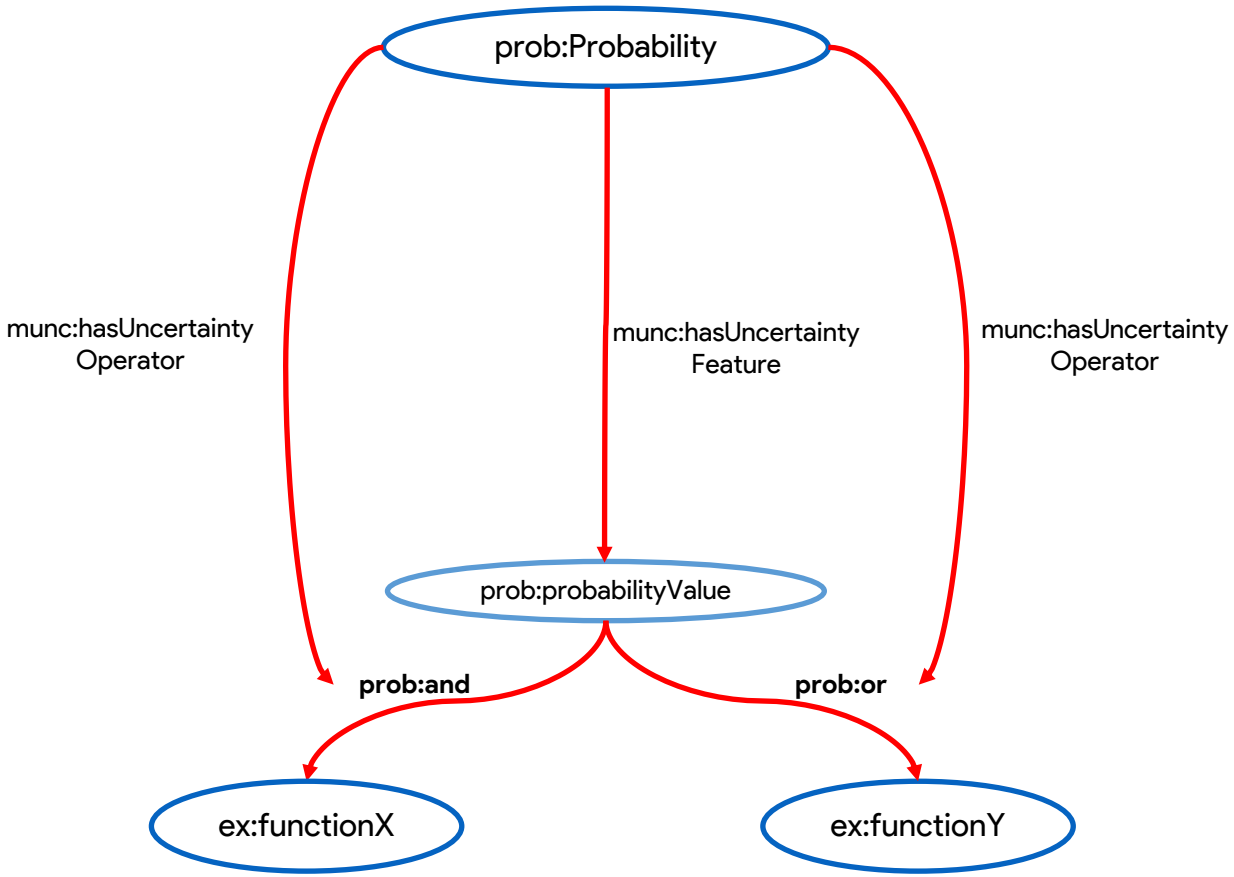
Uncertainty **metadata**

- a set of pairs (*feature*, *value*) : one or a set of compatible uncertainty theories.
- Theories and features are represented by resources.
- The Calculii is represented as a resource, using **LDScript language***

```
ex:S1 munc:hasMeta [
        a munc:Uncertainty;
        prob:probabilityValue 0.7
].

prob:Probability a munc:UncertaintyApproach;
munc:hasUncertaintyFeature prob:probabilityValue;
munc:hasUncertaintyOperator prob:and, prob:or, prob:not.

prob:probabilityValue prob:and prob:multIndependentProb.

function prob:multIndependentProb(?p1, ?p2){
        ?p1 * ?p2
}
```

* ns.inria.fr/sparql-extension/

Example: Uncertainty Theory



- Functions defining the **calculii** of uncertainty features

Example: @metadata

- Transparent integration
- Corese Semantic Web engine
  - LDScript
  - Query visitors
  - Linked Functions
  - Workflows

```
function munc:metaList(?xT, ?xC){
 let(
        SELECT ?xT ?xC (group_concat(?FV;separator="-") as ?metaD) WHERE {
         {
            SELECT ?xT ?xC (CONCAT(?xF,'=',?xV) AS ?FV) WHERE {
             ?xC ?xF ?xV1.
             OPTIONAL {?xT ?xF ?xV2}
             ?xF rdfs:subPropertyOf munc:uncertaintyFeature.
             ?xF ex:and ?xFFunction.
             BIND(IF(BOUND(?xV2),funcall(?xFFunction,?xV1,?xV2),?xV1) AS ?xV)
            } GROUP BY ?xT ?xC
        } UNION {
            SELECT ?xT ?xC (CONCAT(?xF,'=',?xV) AS ?FV) WHERE {
             ?xT ?xF ?xV
             ?xF rdfs:subPropertyOf munc:uncertaintyFeature
             FILTER NOT EXISTS {?xC ?xF ?xV2}
            } GROUP BY ?xT ?xC }
        }
 ){
  ?metaD
 }
}
```

Map Sentences with their Uncertainty Metadata. Using Uncertainty **Calculii**

Context Metadata by default.

Results: « Feature1 = Value1, Feature2= Value2, ... »

Example: @metadata

- Transparent integration
- Corese Semantic Web engine
  - LDScript
  - Query visitors
  - Linked Functions
  - Workflows

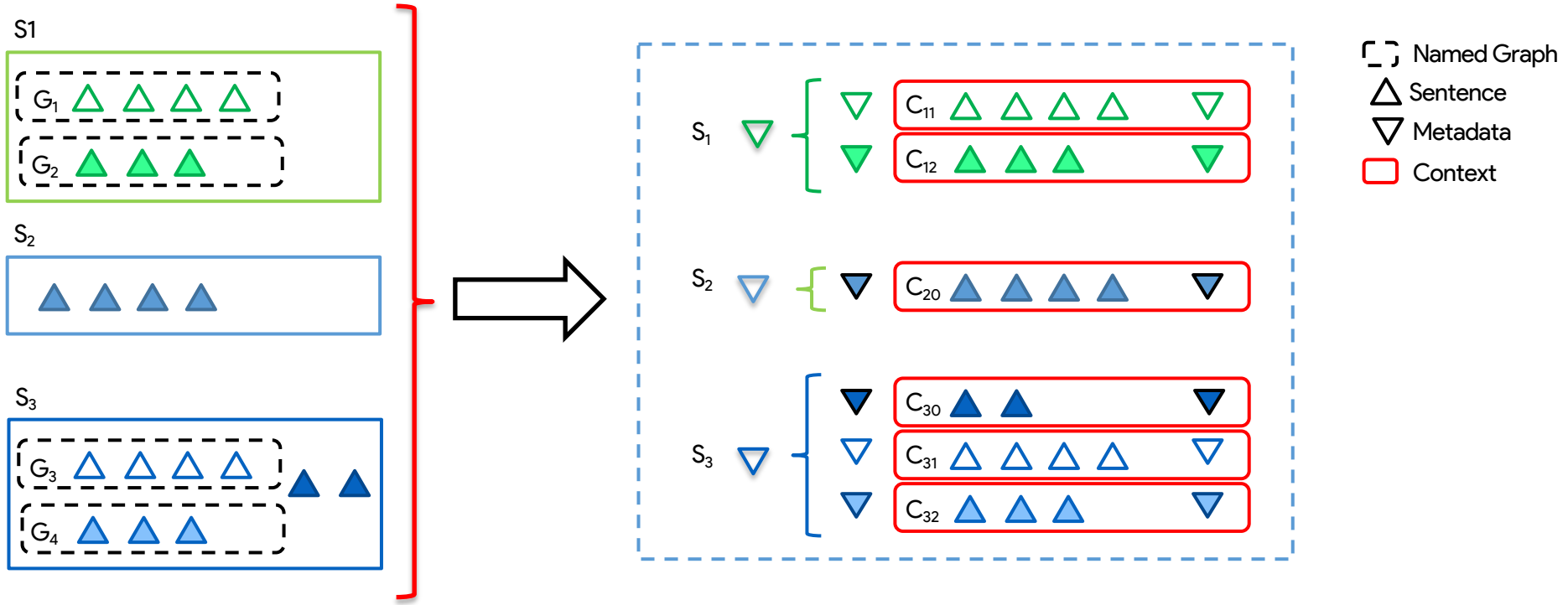
```
prefix ex: <http://example.org/>.

@metadata
SELECT ?g ?s ?p ?o WHERE {
 graph ?g {?s ?p ?o}
}
```

Results:

:subject, :predicate, :Object, « Feature1 = Value1, Feature2= Value2, … »

Uncertainty Representation

Contextualization



Example: Contextualization

:SciFi

:Apple :hasColor :Blue
:Apple :hasColor :Green

:Bio

:Apple :hasColor :Red
:Apple :hasColor :Green
:Apple :hasColor :Yellow

:SciFi :probabilityValue 0.3
:Bio :probabiltiyValue 0.7

- Each context has its own metadata
- Sentence **inherits** context

Example: Practice

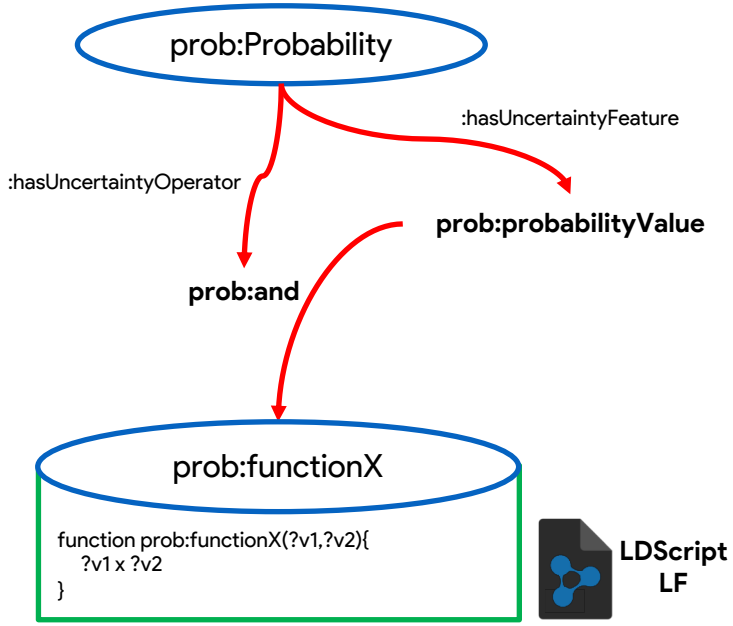
:SciFi

:Apple :hasColor :Blue
:Apple :hasColor :Green {1,dbpedia}

:Bio

:Apple :hasColor :Red
:Apple :hasColor :Green
:Apple :hasColor :Yellow

:SciFi :probabilityValue 0.3
:Bio :probabilityValue 0.7



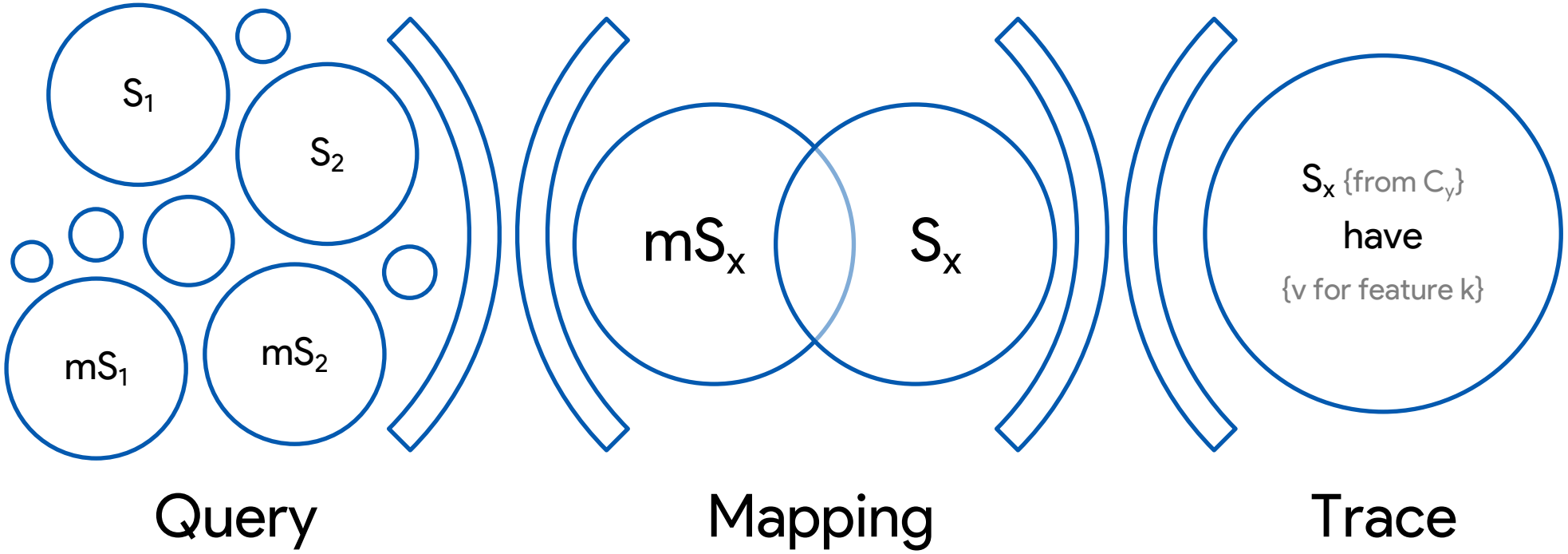
@metadata
SELECT ?color where {:Apple :hasColor ?color}

Results :

1:(:Red,{0.7}),
2:(:Green, U_{S_2} = {1,dbpedia} xor {0.3} xor {prob:functionX(1,0.3)}),
3:(:Yellow,{0.7}),
4:(:Blue,{0.3})

- Selection based on **meta-mapping modes**

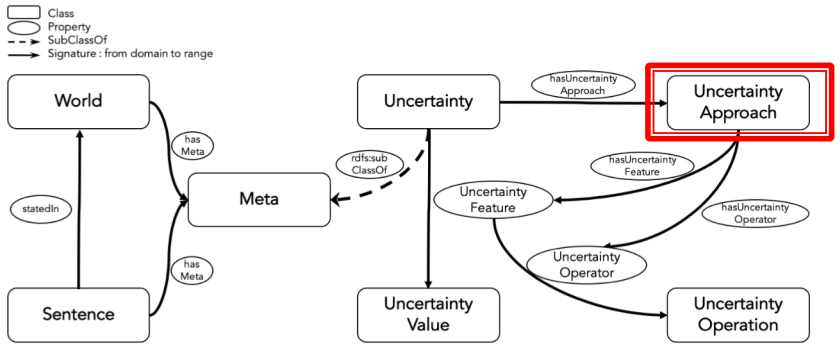
Translating & Negotiating Uncertainty



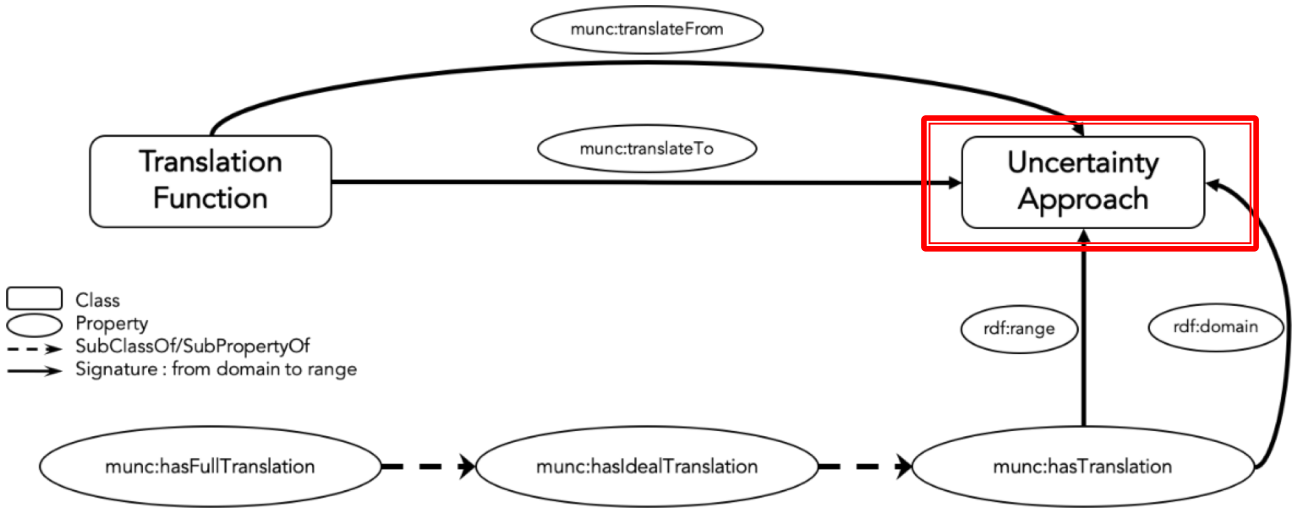
Translating & Negotiating Uncertainty

Querying **Translation** Negotiation

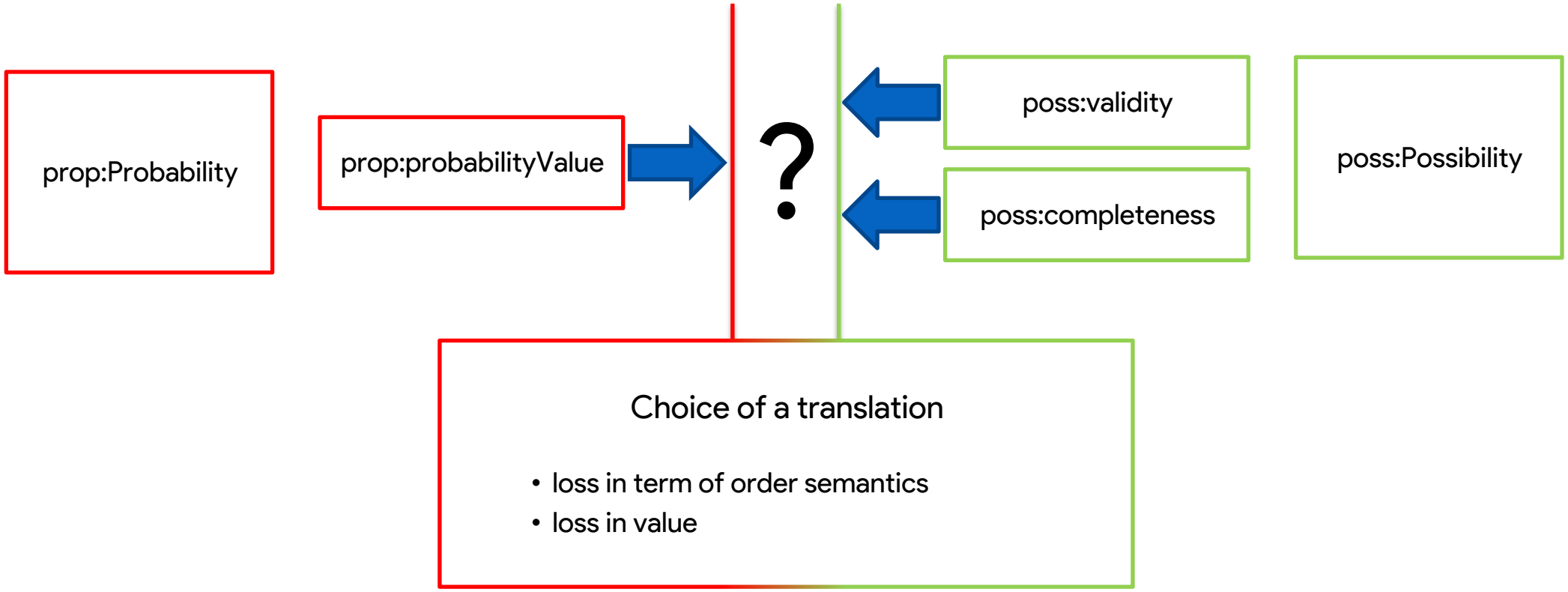
mUnc Vocabulary



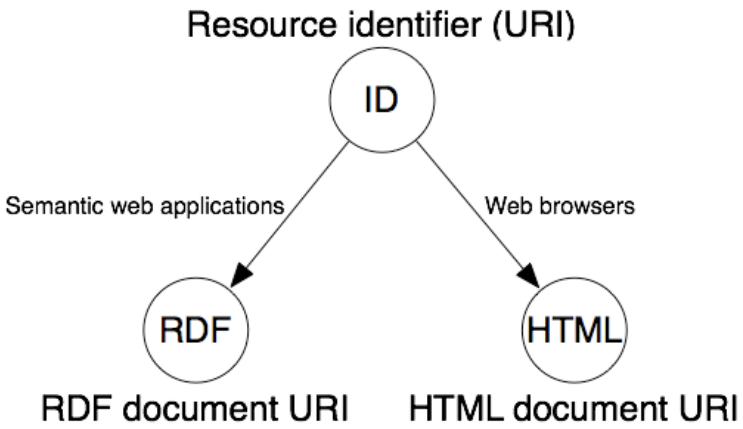
mUnc Translatability Extension



Translating & Negotiating Uncertainty



Example: CONNEG



- Specify uncertainty in parameter linked to the format
  - GET /some/resource HTTP/1.1
    Accept: text/turtle;**uncertainty**="http://example.com/Probability";q=0.8,
    text/turtle;**uncertainty**="http://example.com/Possibility";q=0.2;

- Use uncertainty as a profile : prof-Conneg
  - GET /some/resource HTTP/1.1
    Accept: text/turtle;q=0.8;profile="prob:Probability",
    text/turtle;q=0.2;profile="poss:Possibility"
  - HEAD /some/resource HTTP/1.1
    Accept: text/turtle;q=0.9,application/rdf+xml;q=0.5
    Link: <http://example.com/Probability>; rel="profile" **(RFC 6906)**
  - GET /some/resource HTTP/1.1
    Accept: text/turtle
    Prefer: profile="prob:Probability" **(RFC 7240)**

Content Negotiation by Profile

W3C Working Draft 30 April 2019

This version:
https://www.w3.org/TR/2019/WD-dx-prof-conneg-20190430/

Latest published version:
https://www.w3.org/TR/dx-prof-conneg/

Latest editor's draft:
https://w3c.github.io/dxwg/conneg-by-ap/

Test suite:
https://github.com/CSIRO-enviro-informatics/prof-conneg-test-suite

Implementation report:
https://github.com/CSIRO-enviro-informatics/prof-conneg-implementations

Previous version:
https://www.w3.org/TR/2018/WD-dx-prof-conneg-20181218/

Latest Recommendation:
https://www.w3.org/TR/2018/WD-dx-prof-conneg-20181218/

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Commit history
Pull requests

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Credits: w3.org/TR/cooluris/, w3.org/TR/dx-prof-conneg/

Translating & Negotiating Uncertainty

Querying Translation **Negotiation**

GET /some/resource HTTP/1.1
Accept: text/turtle;uncertain="http://example.org/probability"; q=0.9

SERVER

HTTP/1.1 200 OK
Content-Type: text/turtle;
uncertain=
http://example.org/probability

Information exist and is

Information is served

HTTP/1.1 200 OK
Content-Type: text/turtle;
uncertain=
http://example.org/possibility;
translation=full

Information exist within another theory

Information is translated and served (Full, ideal, or normal)

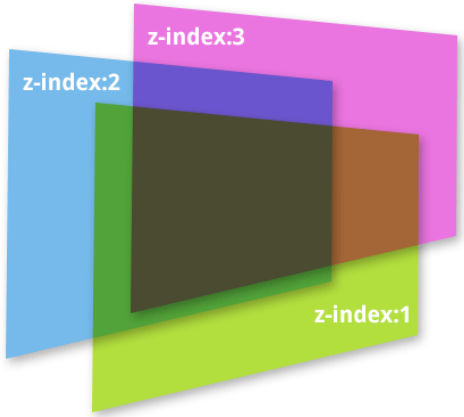
HTTP/1.1 200 OK
Content-Type: text/turtle;
uncertain=
http://example.org/possibility;
default=true

Information do not exist under the requested theory, no available translations

Default theory is served

Perspectives

- Weighted contexts
  ... and why not, nested contexts
- Uncertainty dictionnary
  - Theories, features and calculus
  - Translations
- Triple-Stored Calculii (ex: STATO + R)
- Uncertainty as an application of **RDF*** *

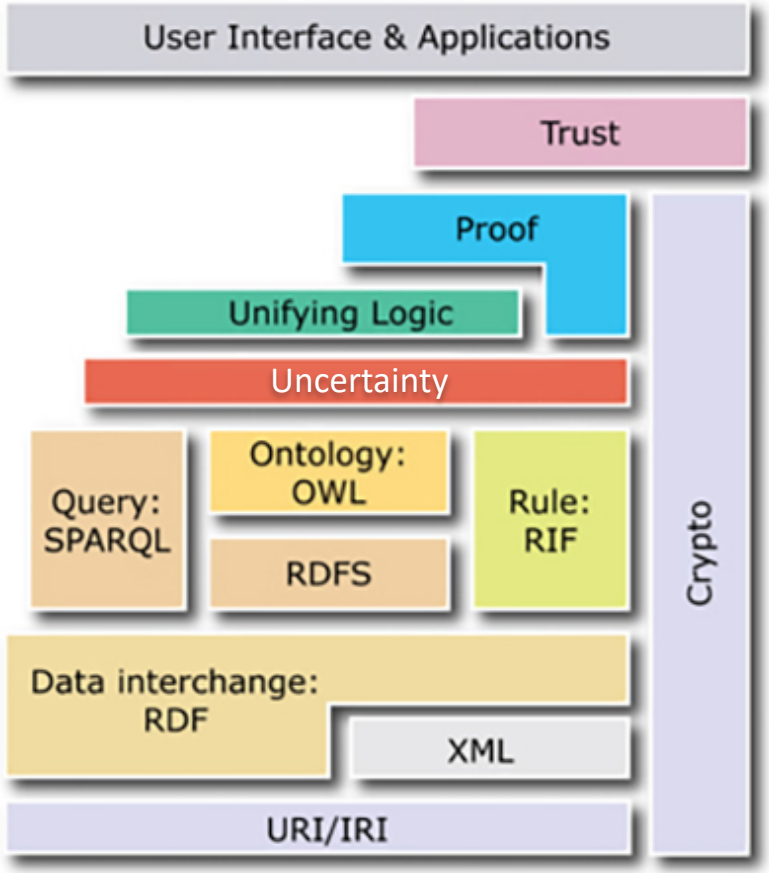


* Hartig, O. (2017). Foundations of RDF* and SPARQL* : (An Alternative Approach to Statement-Level Metadata in RDF).

Conclusion

- URW3-XG
- PROV-O
- **mUnc**

- **Stephano Tacconi** is an italian soccer player (1.88m)



Thank You

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