

Knowledge Graphs

Lecture 1 - Knowledge Graphs in the Web of Data

1.5 The Semantic Web

Prof. Dr. Harald Sack & Dr. Mehwish Alam

FIZ Karlsruhe - Leibniz Institute for Information Infrastructure

AIFB - Karlsruhe Institute of Technology

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Leibniz-Institut für Informationsinfrastruktur

Knowledge Graphs

Lecture 1: Knowledge Graphs in the Web of Data

1.1 Data, Information, and Knowledge

1.2 How to Represent Knowledge?

1.3 The Art of Understanding

1.4 Towards a Universal Knowledge Representation

1.5 The Semantic Web

1.6 Linked Data and the Web of Data

The Semantic Web Technology Stack (not a piece of cake...)

Most apps use only a subset of the stack

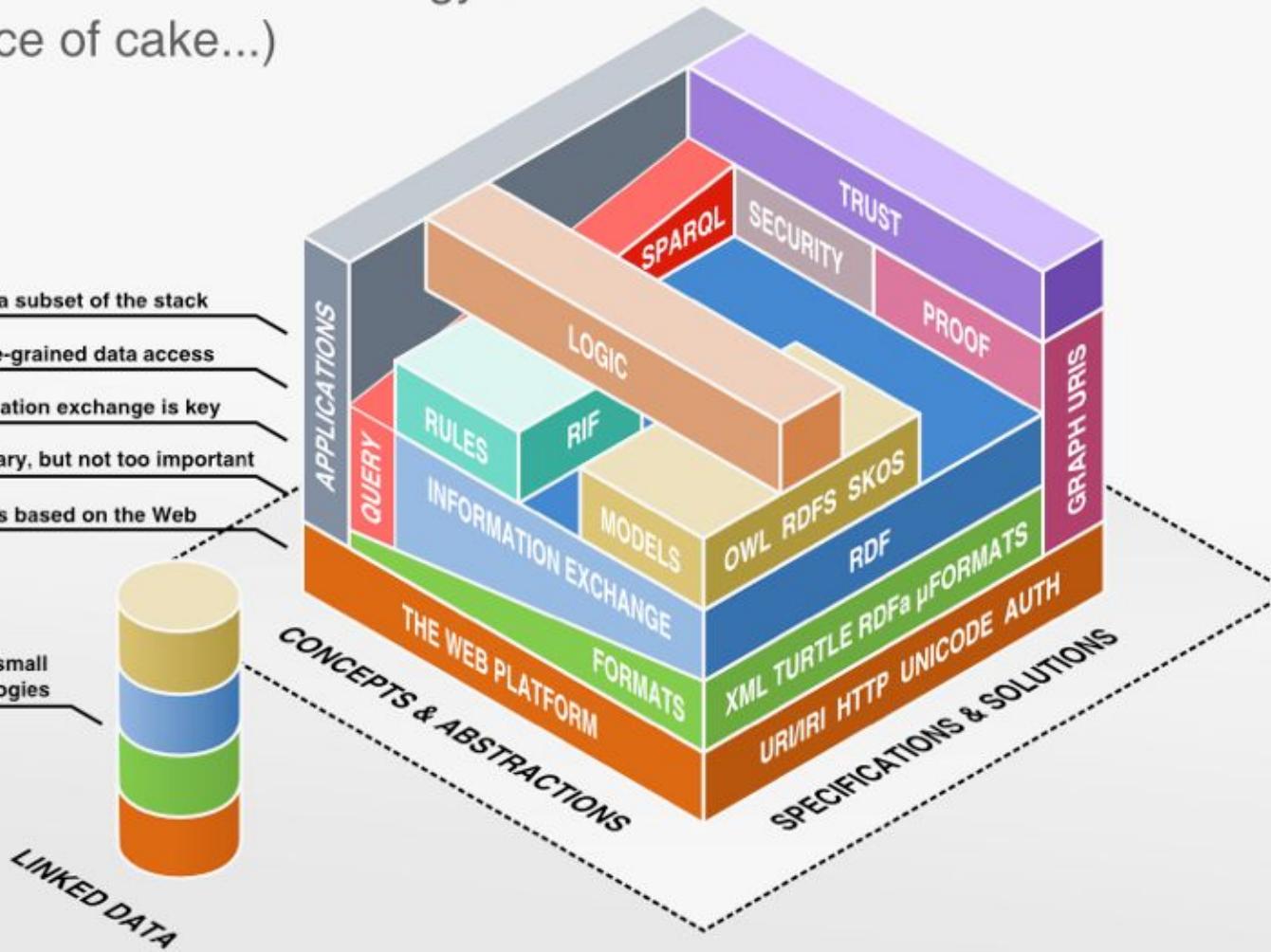
Querying allows fine-grained data access

Standardized information exchange is key

Formats are necessary, but not too important

The Semantic Web is based on the Web

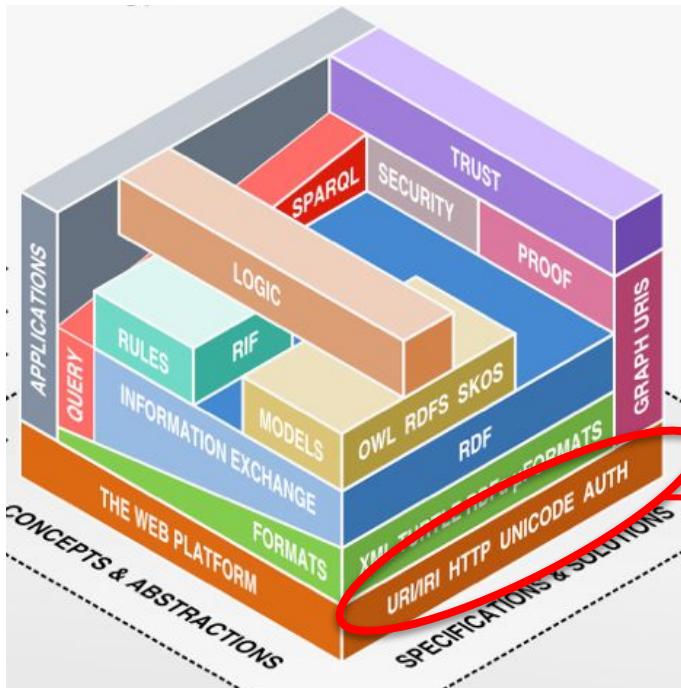
Linked Data uses a small selection of technologies



The Semantic Web - A Web of Data

- The Semantic Web is an **Extension of the current Web**.
- The meaning of information (Semantics) is made explicit by **formal (structured) and standardized knowledge representations (Ontologies)**.
- Thereby it will be possible,
 - to **process** the meaning of information automatically
 - to **relate** and **integrate** heterogeneous data
 - to **deduce** implicit (not evident) information from existing (evident) information in an automated way.
- The Semantic Web is kind of a **global database** that contains a **universal network of semantic propositions**.

The Semantic Web Technology Stack

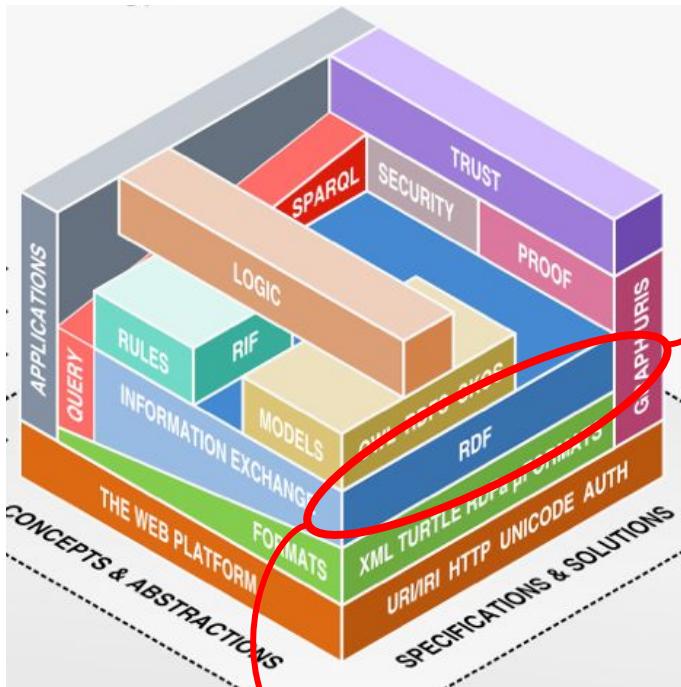


URI - Uniform Resource Identifier

Mount Everest

→ http://dbpedia.org/resource/Mount_Everest

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RDF Triple

http://dbpedia.org/resource/Mount_Everest

```
:Mount_Everest rdf:type dbo:Mountain .
:Mount_Everest foaf:name "Mount Everest"@en .
:Mount_Everest dbo:elevation 8848 .
:Mount_Everest dbo:namedAfter :George_Everest .
:George_Everest rdf:type dbo:Person .
:George_Everest dbo:birthdate "1790-07-04"^^xsd:date .
...
```

RDF Resource Description Framework

:Mount_Everest

RDF Subject

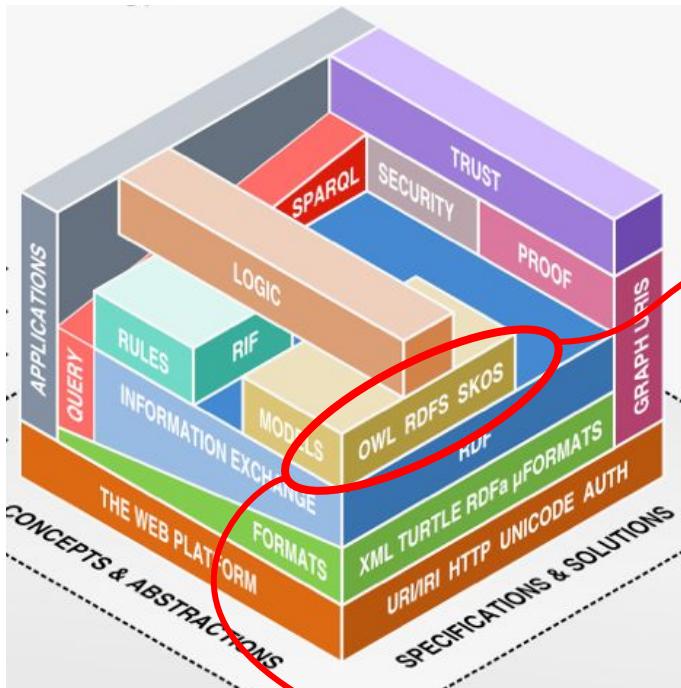
rdf:type

RDF Property

dbo:Mountain

RDF Object

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<http://dbpedia.org/ontology/Mountain>

```

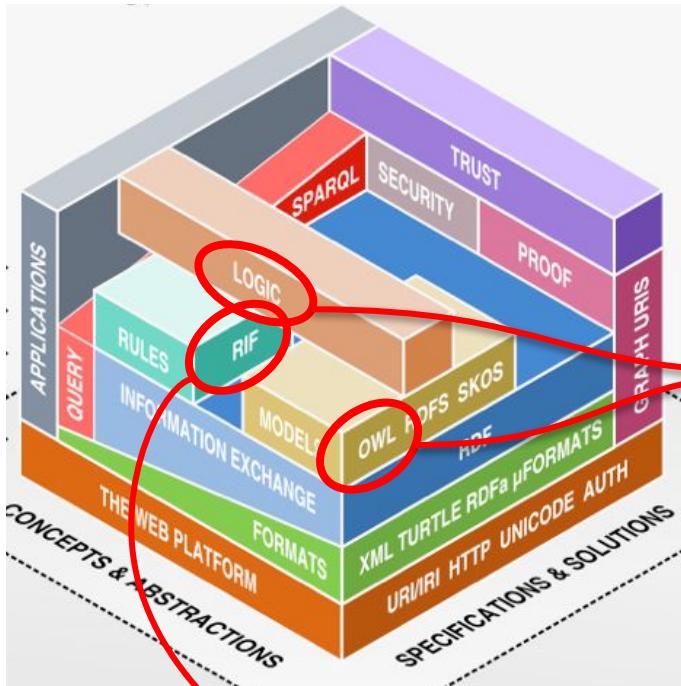
dbo:Mountain rdf:type owl:Class .
dbo:Mountain rdfs:subClassOf dbo:Landform .
dbo:elevation rdf:type rdf:Property .
dbo:elevation rdfs:domain owl:Thing .
dbo:elevation rdfs:range xsd:integer .
dbo:namedAfter rdf:type rdf:Property .
dbo:namedAfter rdfs:domain owl:Thing .
dbo:namedAfter rdfs:range dbo:Person .
...
  
```



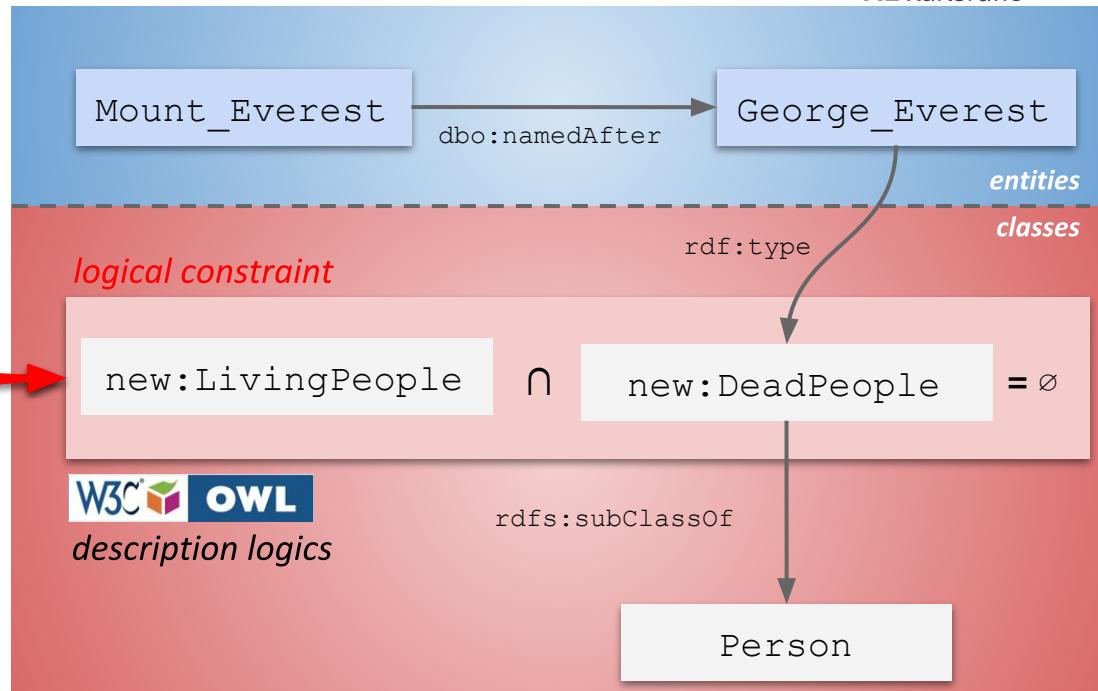
RDF Schema



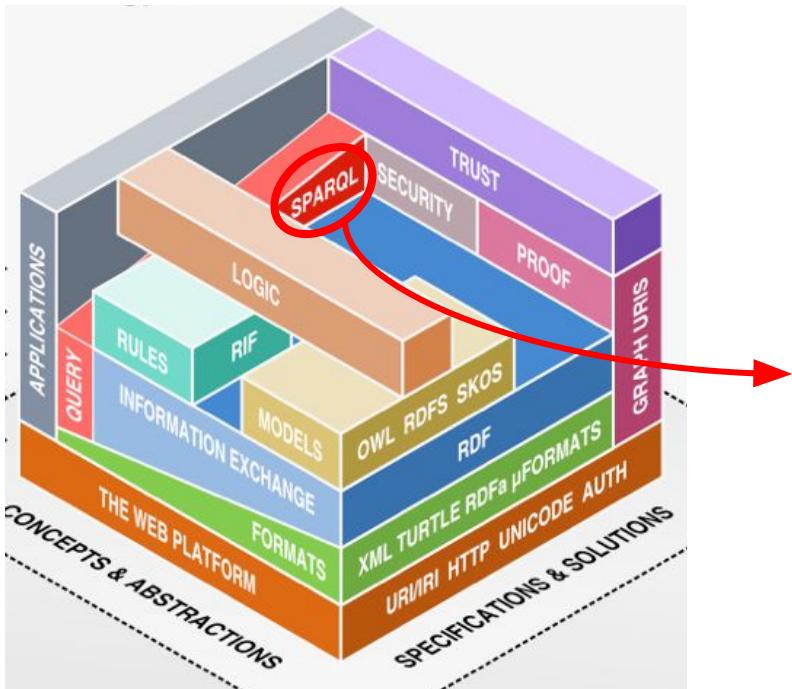
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+ logical rules

$$\forall x. \exists y. \text{deathDate}(x, y) \wedge \text{Person}(x) \wedge \text{Date}(y) \rightarrow \text{DeadPeople}(x)$$


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List all **Mountains** and the people who died there ordered by the number of deaths...



PREFIX rdf: <<https://www.w3.org/1999/02/22-rdf-syntax-ns#t>>

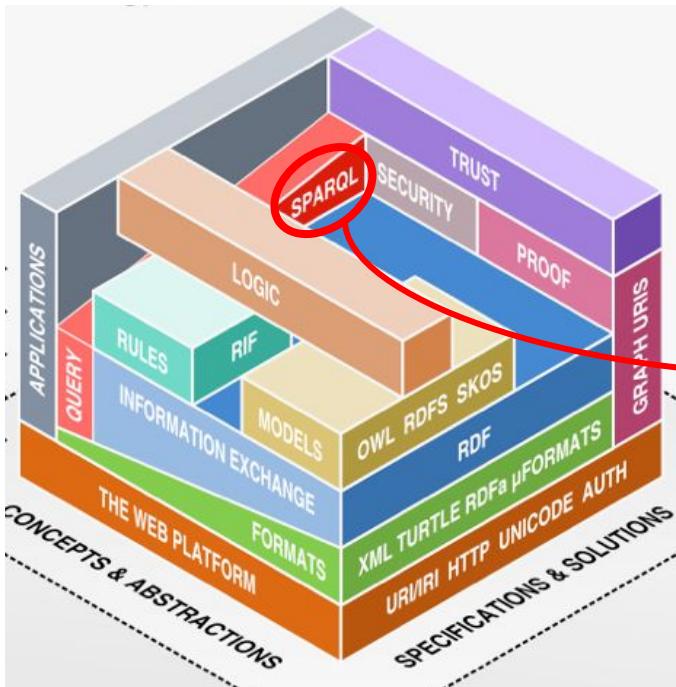
PREFIX dbo: <<http://dbpedia.org/ontology/>>

```

SELECT DISTINCT ?mountain (COUNT(?person) as ?cnt)
WHERE {
?mountain rdf:type dbo:Mountain .
?person dbo:deathPlace ?mountain .
}
GROUP BY ?mountain
ORDER BY DESC(?cnt)
  
```

[try SPARQL query at public DBpedia SPARQL endpoint](#)

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List all **Mountains** and the people who died there ordered by the number of deaths...



```
#defaultView:Timeline
SELECT DISTINCT ?mountain ?mountainLabel ?person ?personLabel
    ?date ?image
WHERE {
    ?mountain wdt:P31 wd:Q8502 .
    ?person wdt:P20 ?mountain .
    ?person wdt:P570 ?date .
    OPTIONAL {?person wdt:P18 ?image .}
    SERVICE wikibase:label
    { bd:serviceParam wikibase:language "en, de, fr, es, it" }
}
```

[try SPARQL query at public Wikidata SPARQL endpoint](#)

The Semantic Web Technology Stack





Linked Data and the Web of Data

Next Lecture...

Picture References:

- [1] Benjamin Nowack, *The Semantic Web - Not a Piece of cake...*, at bnode.org, 2009-07-08 , [CC BY 3.0]
<http://bnode.org/blog/2009/07/08/the-semantic-web-not-a-piece-of-cake>
- [2] The Linked Open Data Cloud, <https://lod-cloud.net/>