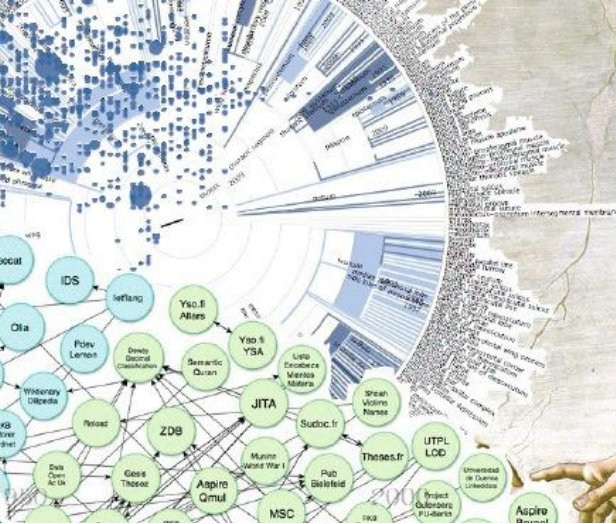




Leibniz Institute for Information Infrastructure



1

Information Service Engineering

Lecture 3: Linked Data Engineering I

3.1 Understanding Data on the Web

3.2 Towards a Universal Data Representation

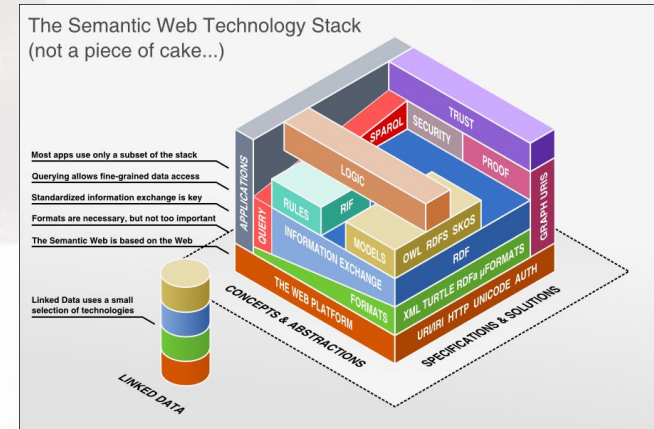
3.3 How to Identify and Access Linked Data

3.4 Representing Facts with RDF

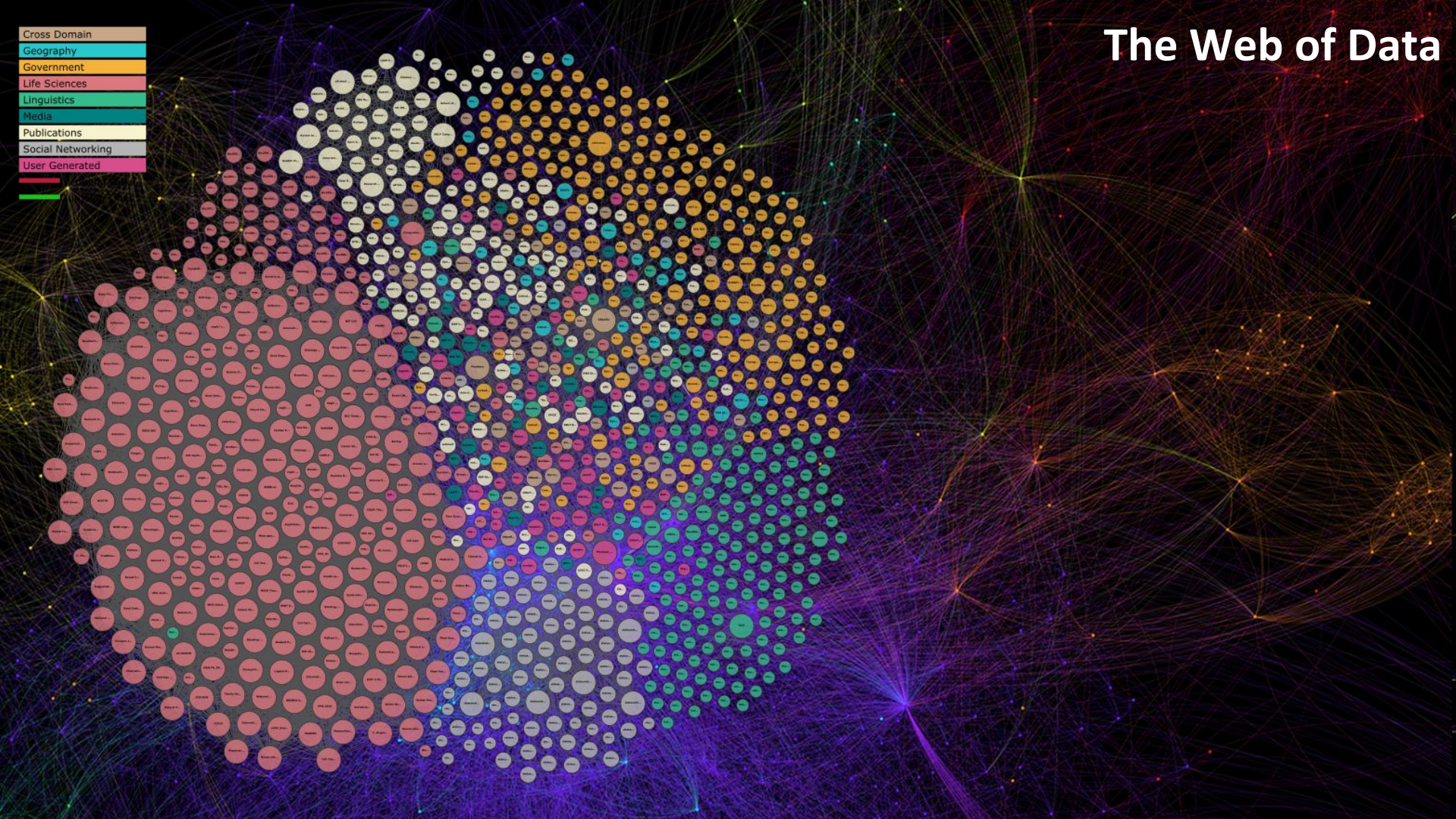
3.5 RDF Turtle Serialization

3.6 Model Building with RDFS

3.7 Logical Inference with RDF(S)

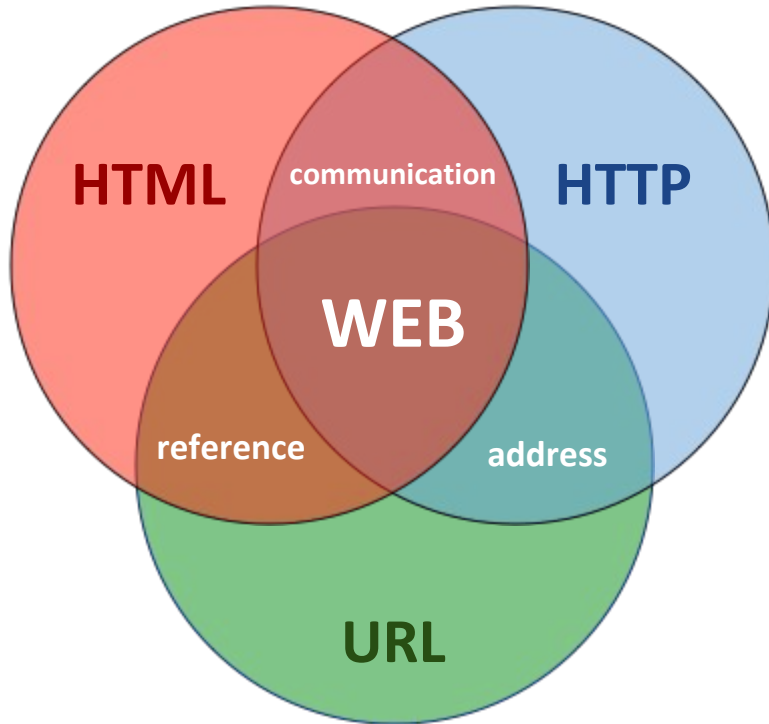


The Web of Data



The Basic Architecture of the Web

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1. Identification (URI) & address (**URL**)

e.g. `http://fiz-karlsruhe.de`

2. Communication / protocol (**HTTP**)

`GET /index HTTP/2`

`Host: fiz-karlsruhe.de`

3. Representation language (**HTML**)

Mary works at

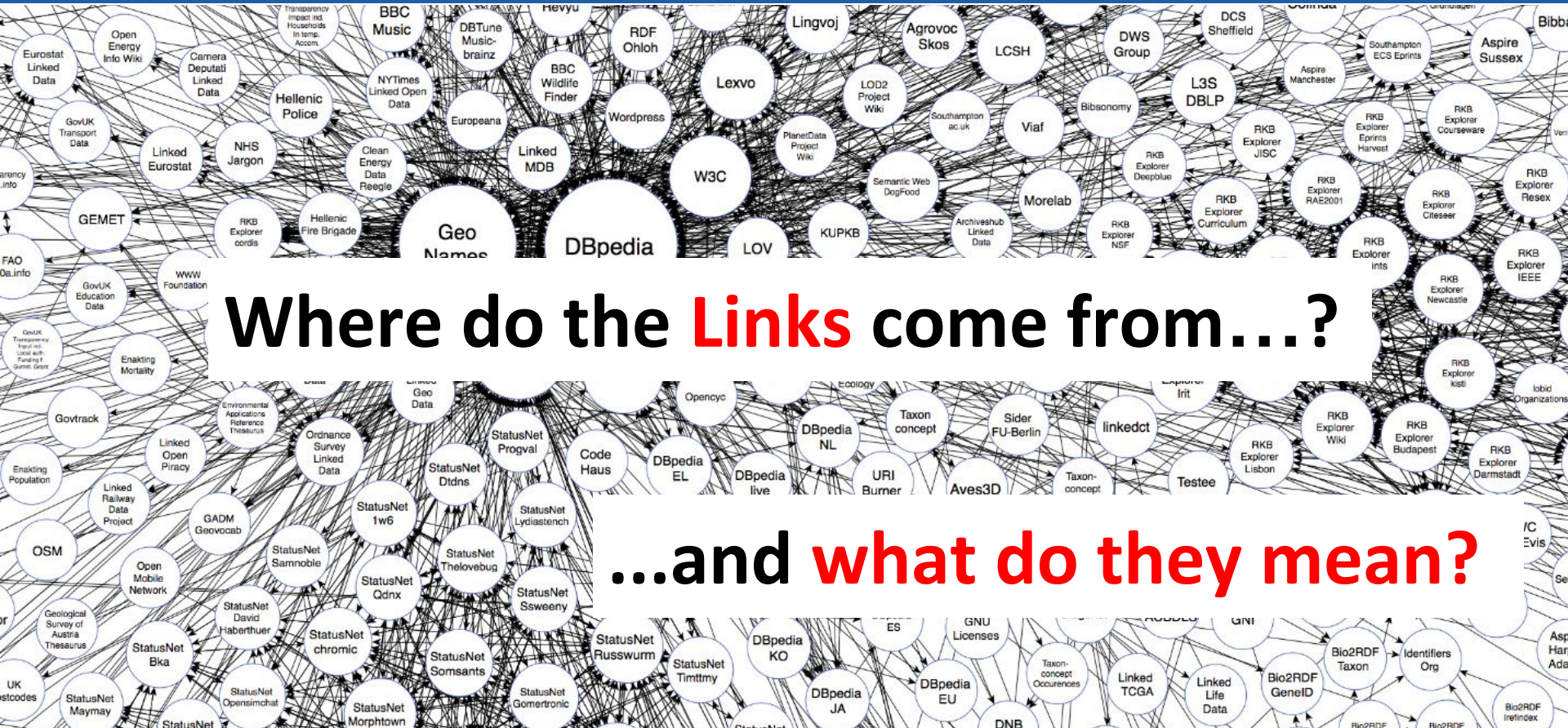
`<a`

`href="http://fiz-karlsruhe.de">`

`FIZ</a>.`

The Web of Linked Data

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Where do the **Links** come from...?

...and **what do they mean?**

The Semantic Web

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„The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation“

Tim Berners-Lee, James Hendler, Ora Lassila: [The Semantic Web](#), Scientific American, 284(5), pp. 34-43(2001)

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

Most apps use only a subset of the stack

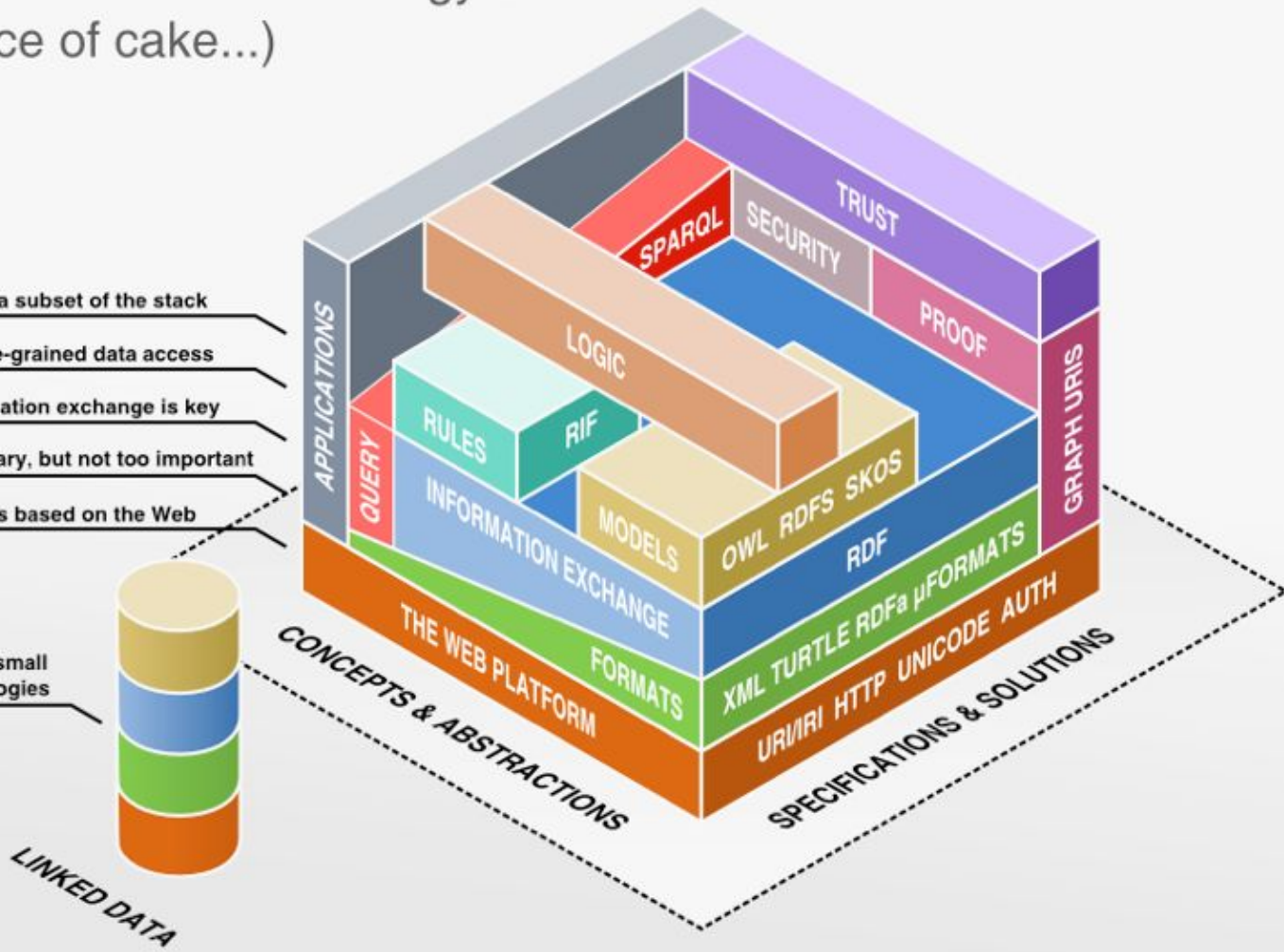
Querying allows fine-grained data access

Standardized information exchange is key

Formats are necessary, but not too important

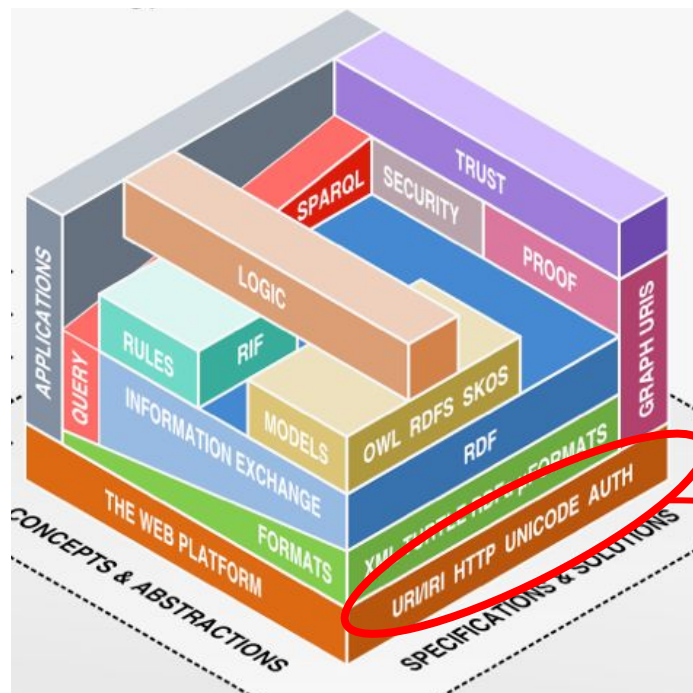
The Semantic Web is based on the Web

Linked Data uses a small selection of technologies



Semantic Web Technology Stack

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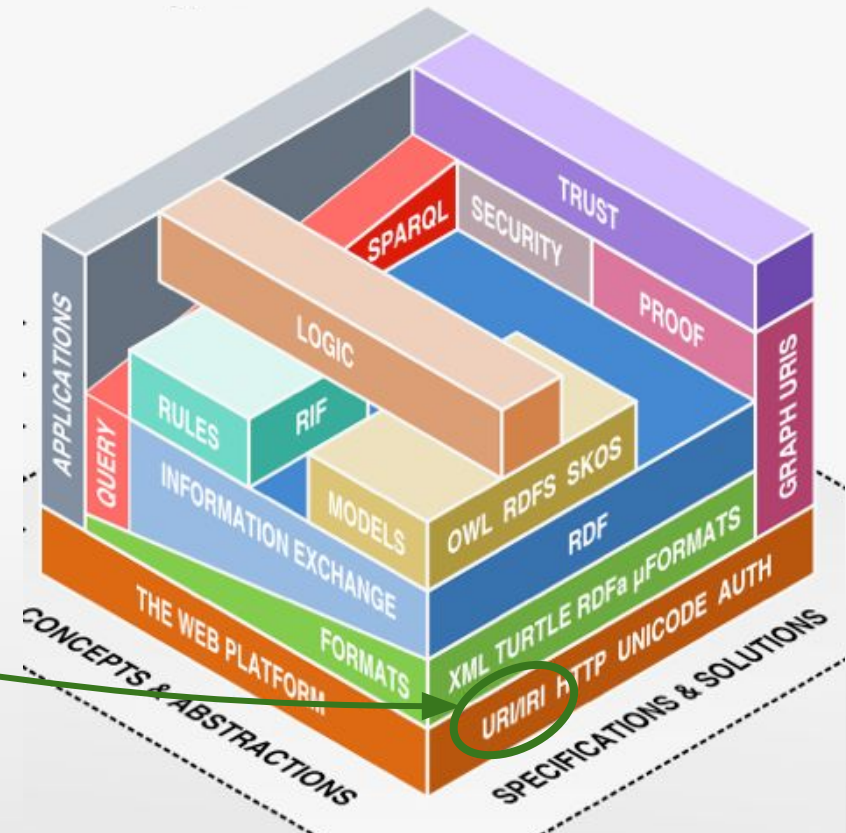
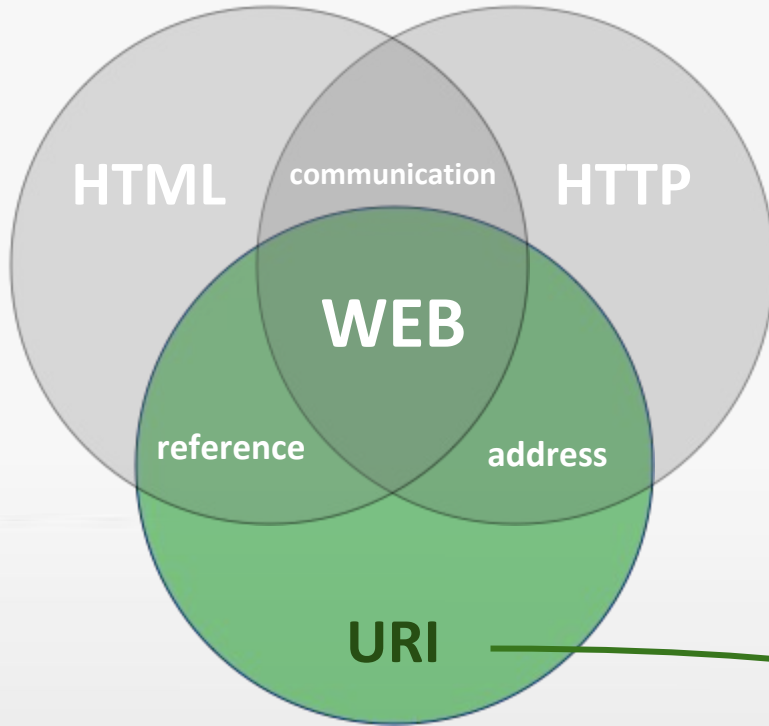


Pluto

<http://dbpedia.org/resource/Pluto>

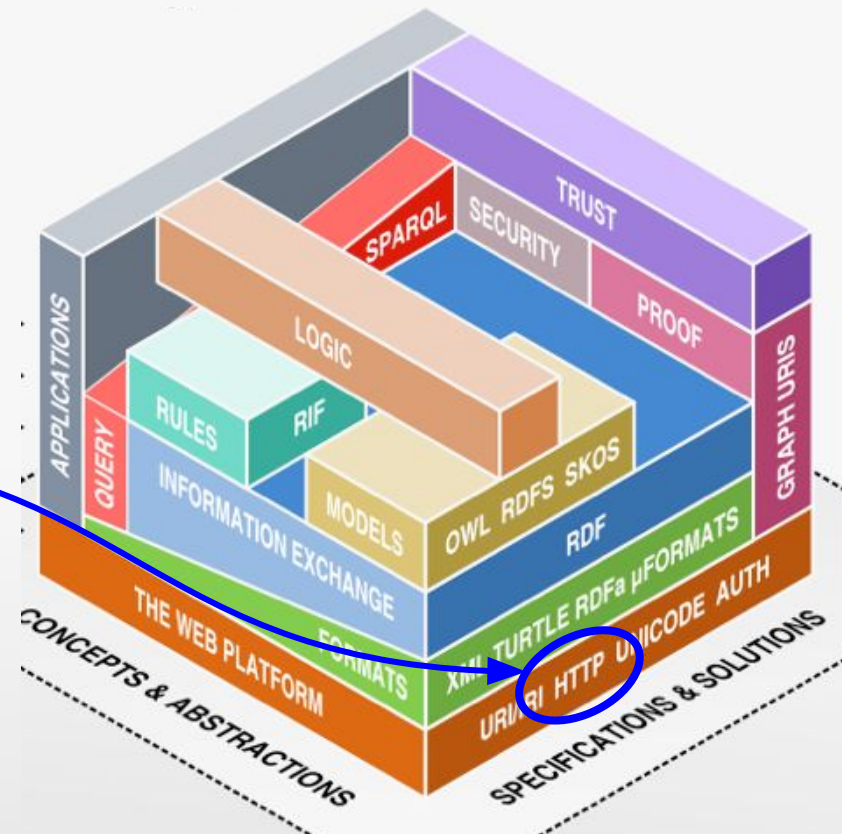
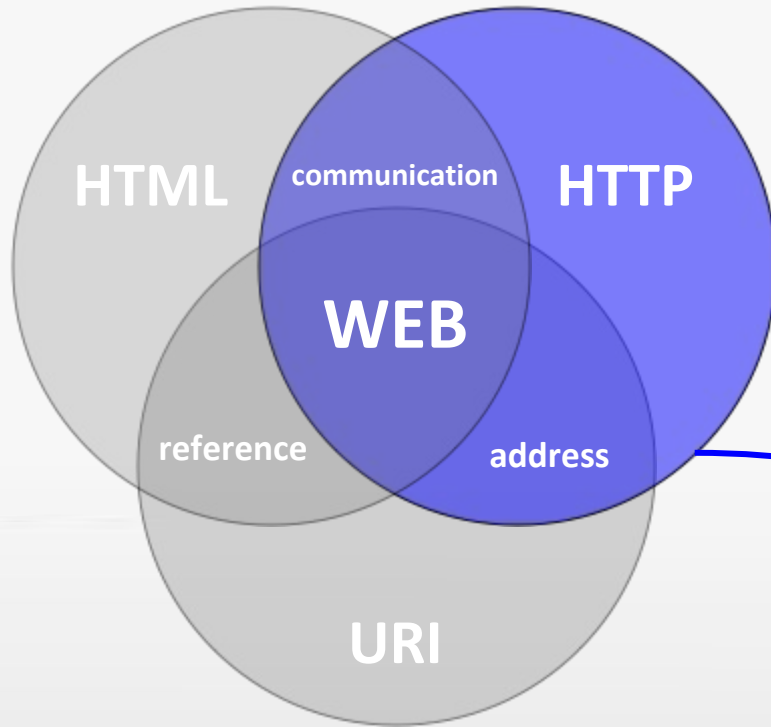
Semantic Web Technology Stack

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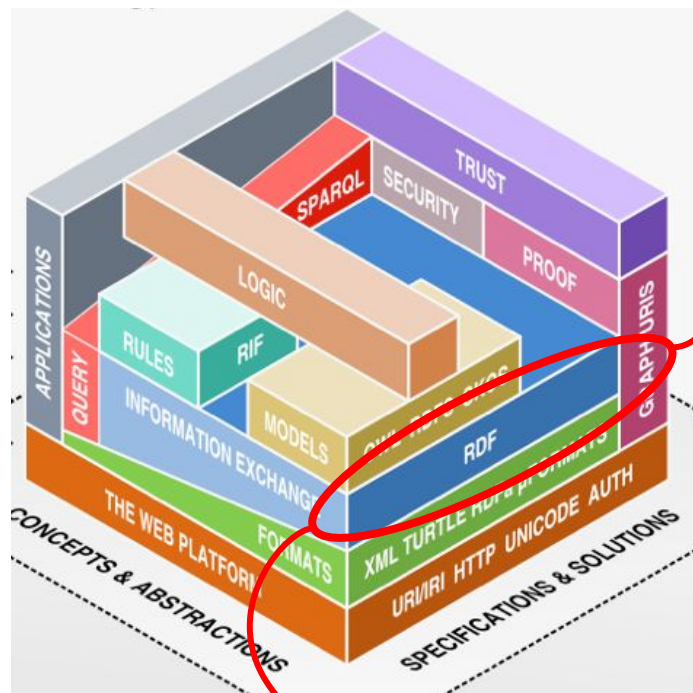
Semantic Web Technology Stack

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<http://dbpedia.org/resource/Pluto>

```
:Pluto rdf:type dbo:CelestialBody .
:Pluto foaf:name "Pluto"@en .
:Pluto dbo:discoverer :Clyde_Tombaugh .
:Pluto dbo:discovered "1930-02-18"^^xsd:date .
:Clyde_Tombaugh rdf:type dbo:Person .
:Clyde_Tombaugh dbo:birthdate "1906-02-04"^^xsd:date .
...
```



RDF Resource Description Framework



RDF Triple

:Pluto

RDF Subject

rdf:type

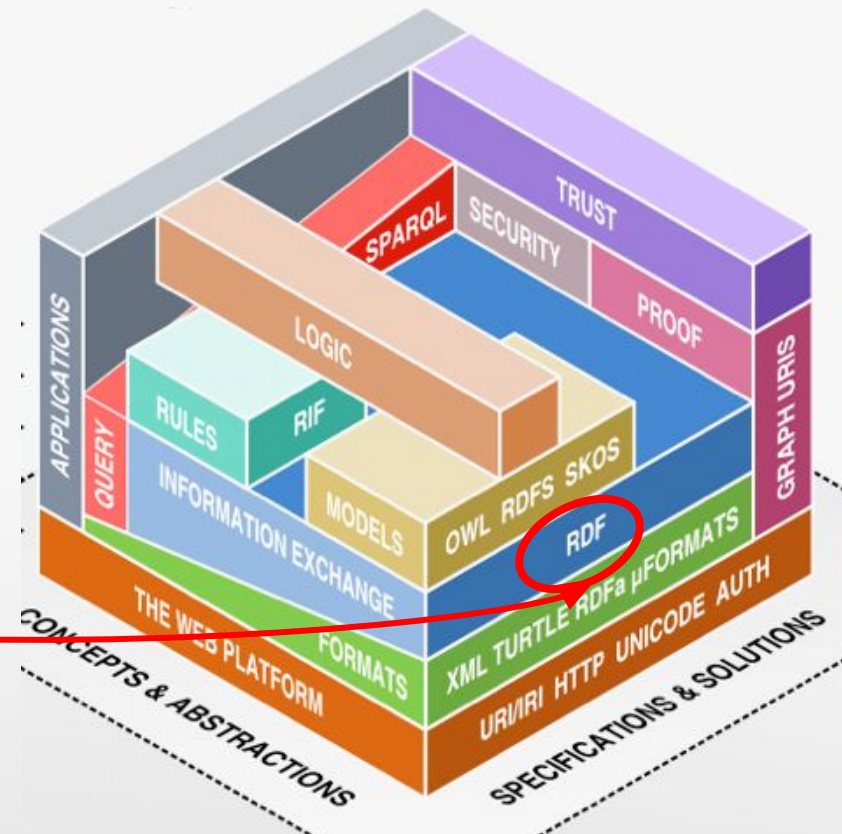
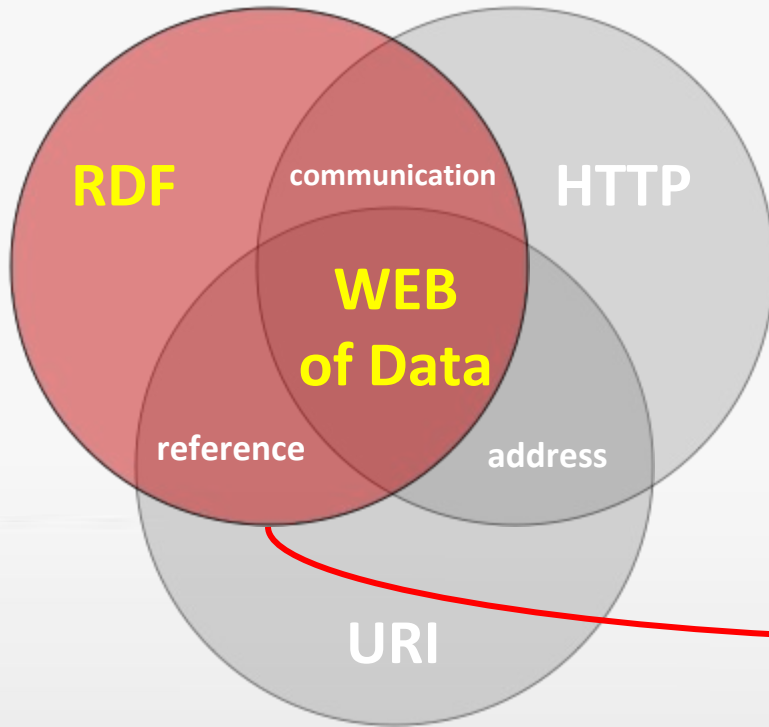
RDF Property

dbo:Dwarf_planet.

RDF Object

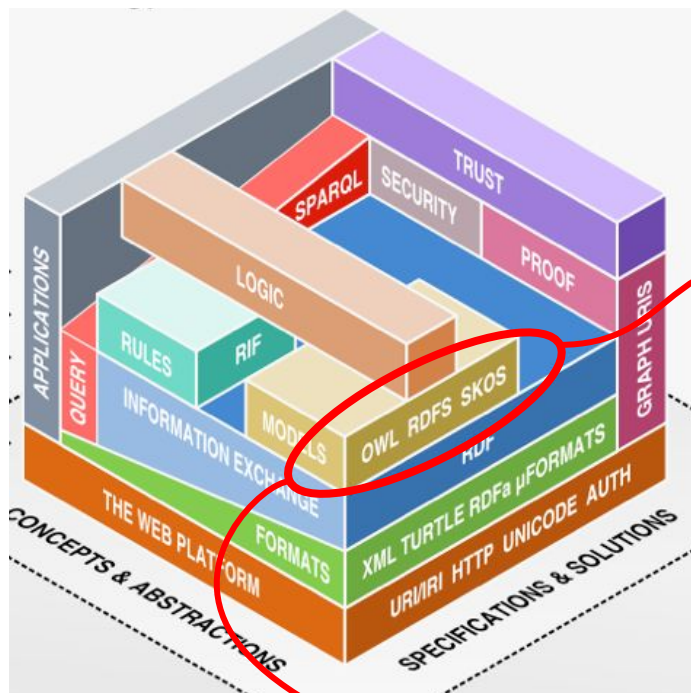
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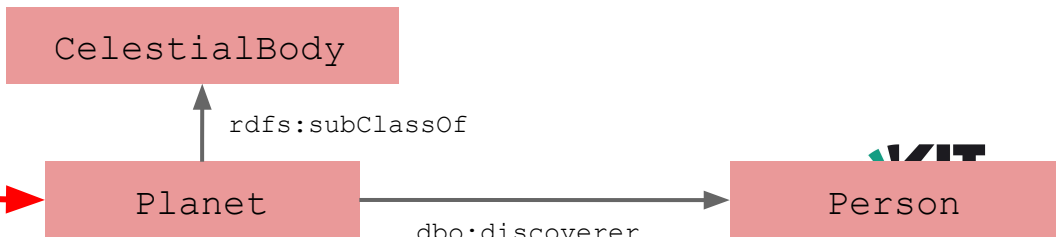


<http://dbpedia.org/ontology/Planet>

```
dbo:Planet rdf:type owl:class .
dbo:Planet rdfs:subClassOf dbo:CelestialBody .
dbo:discovered rdf:type rdf:Property .
dbo:discovered rdfs:domain owl:Thing .
dbo:discovered rdfs:range xsd:date .
dbo:discoverer rdf:type rdf:Property .
dbo:discoverer rdfs:domain owl:Thing .
dbo:discoverer rdfs:range dbo:Person .
...
```

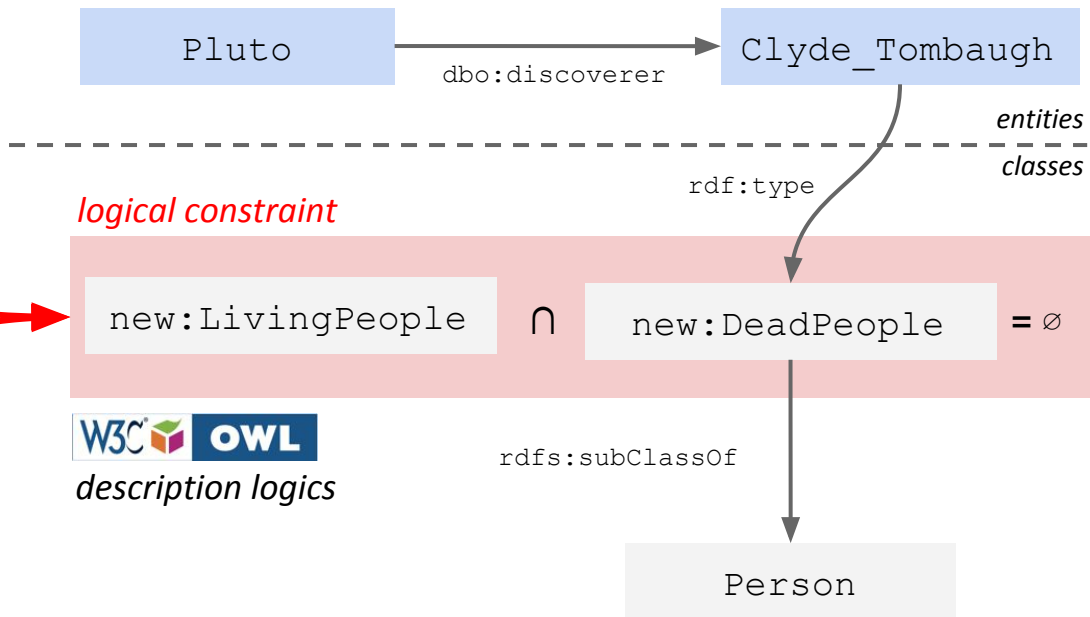
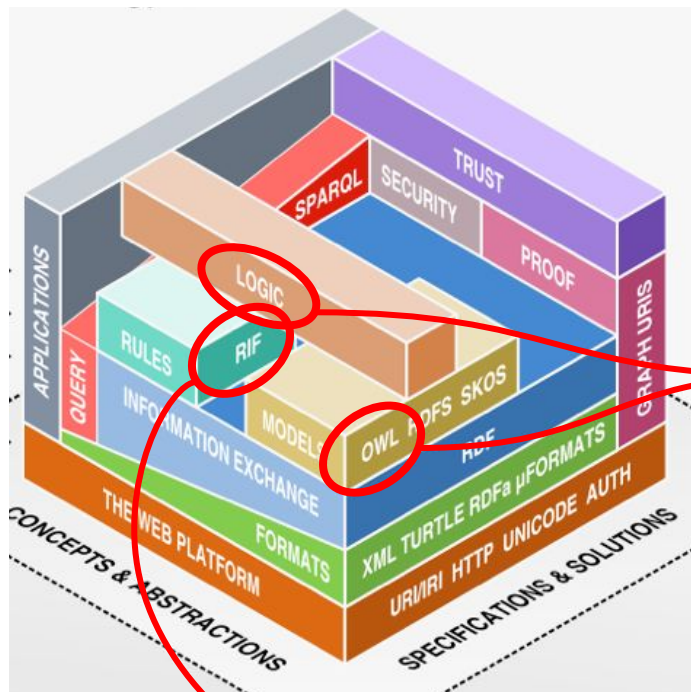


RDF Schema



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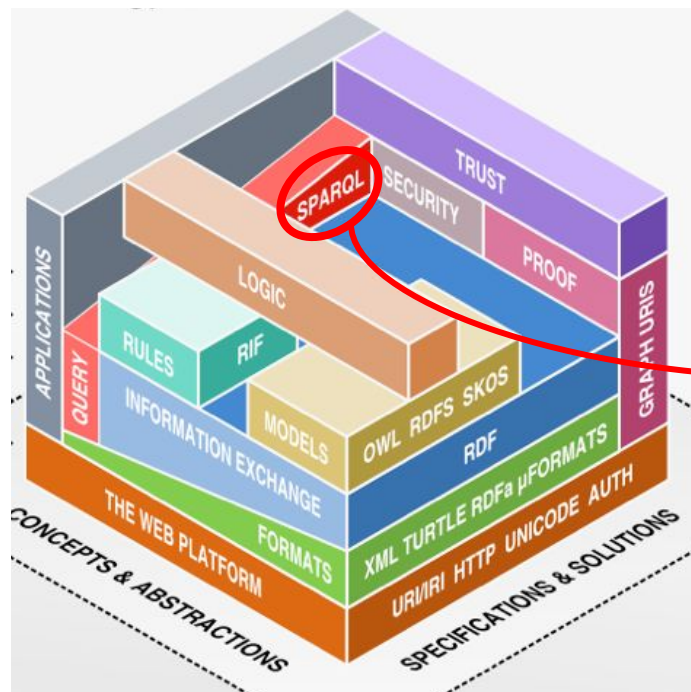


+ *logical rules*

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

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Look for all **Celestial Bodies** that have been **named after** a **Greek or Roman Deity**

```
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX dbp: <http://dbpedia.org/property/>
PREFIX dbc: <http://dbpedia.org/resource/Category:>
```

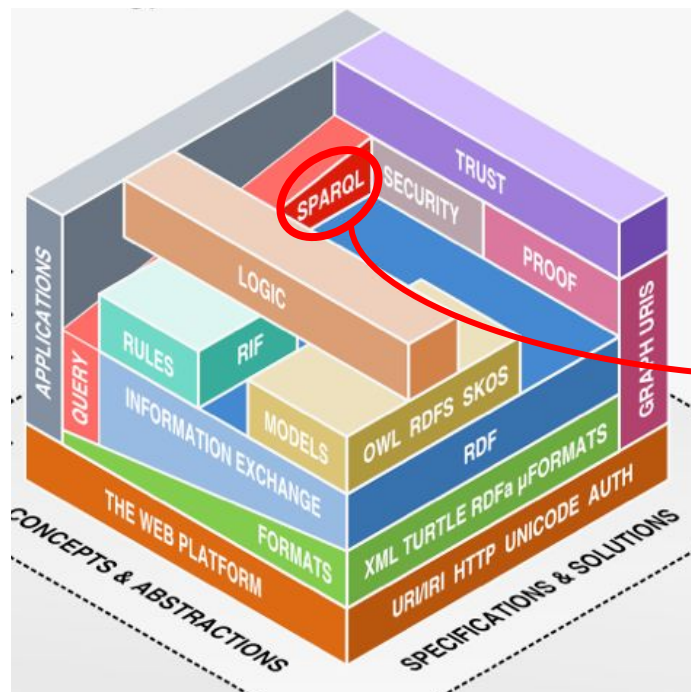
```
SELECT DISTINCT * WHERE {
  ?subject rdf:type dbo:CelestialBody ;
             dbp:namedAfter ?namesake .
  {?namesake dct:subject dbc:Roman_gods .}
  UNION
  {?namesake dct:subject dbc:Greek_gods .}
}
```

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



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Look for all **Celestial Bodies** that have been **named after** a **Greek or Roman Deity**

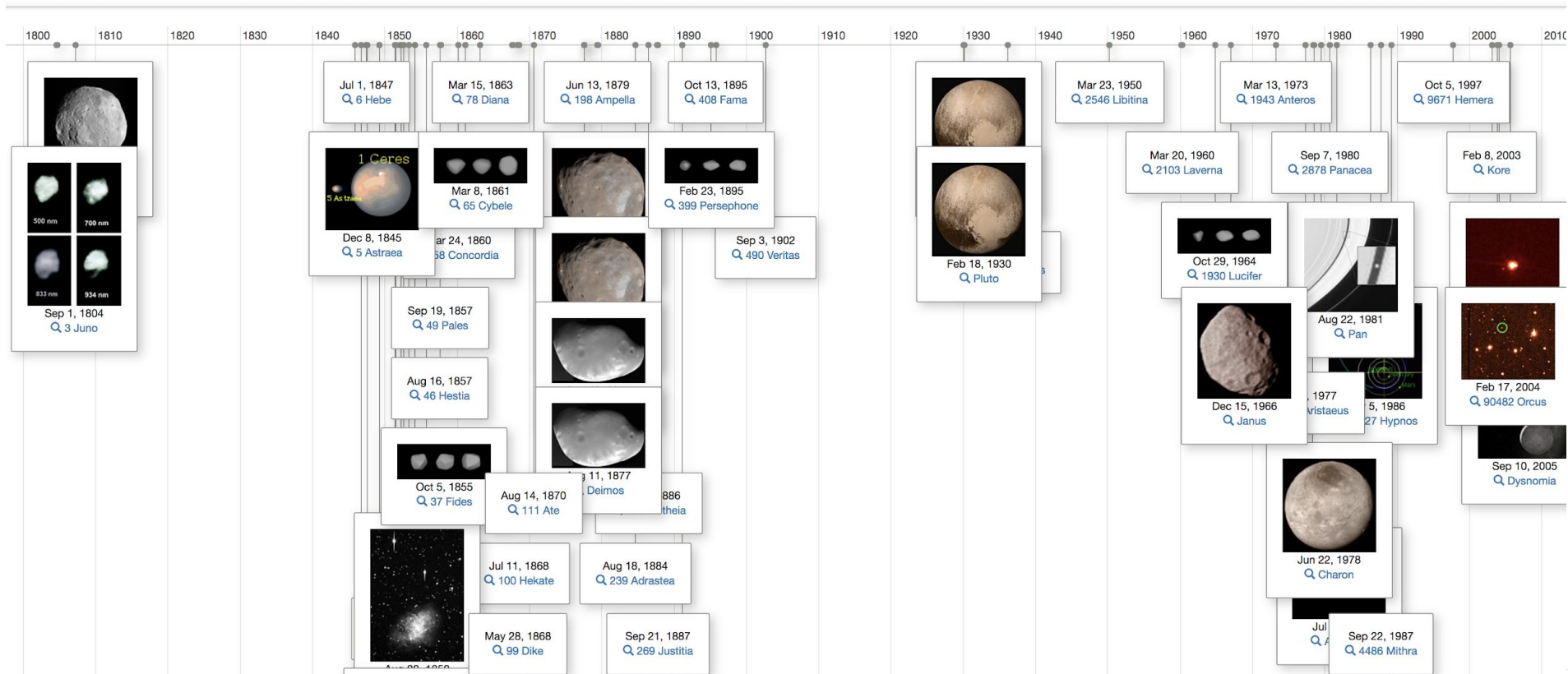


```
#defaultView:Timeline
SELECT DISTINCT ?subjectLabel ?time ?image ?subject WHERE {
  ?subject wdt:P31/wdt:P279* wd:Q6999 ;
    wdt:P138 ?namesake ;
    wdt:P575 ?time .
  OPTIONAL {?subject wdt:P18 ?image .}
  { ?namesake wdt:P31 wd:Q22989102 .}
  UNION
  { ?namesake wdt:P31 wd:Q11688446 .}
  SERVICE wikibase:label { bd:serviceParam wikibase:language "en" }
}
```

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

Semantic Web Technology Stack

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DR. JEKYLL and MR. HYDE

How to Identify and
Access Linked Data

Information Service Engineering

3.2 Towards a Universal Data Representation

Picture References:

- P.3: The Linking Open Data Cloud Diagram, <http://lod-cloud.net/>
- P.7: The Semantic Web Technology Stack, via http://bnode.org/media/2009/07/08/semantic_web_technology_stack.png
- P.18: Poster for a theatrical adaptation of Strange Case of Dr Jekyll and Mr Hyde.
This image is available from the United States Library of Congress's Prints and Photographs division under the digital ID [cph.3g08267](https://www.loc.gov/pictures/item/cph.3g08267)