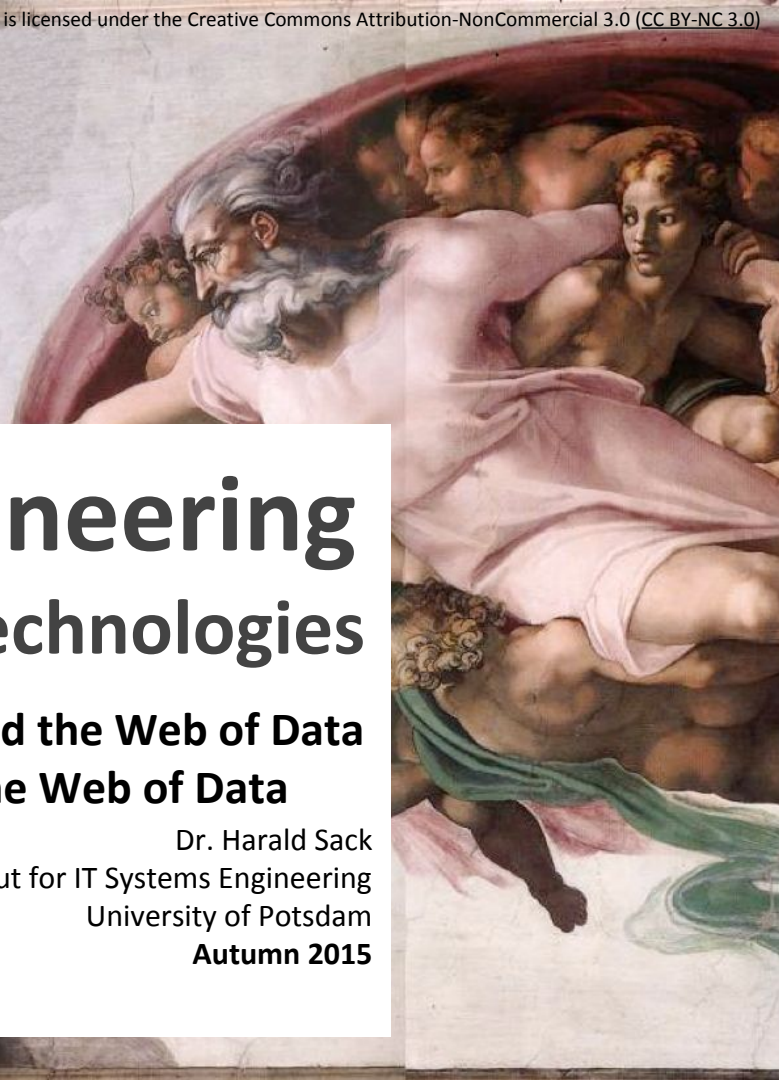
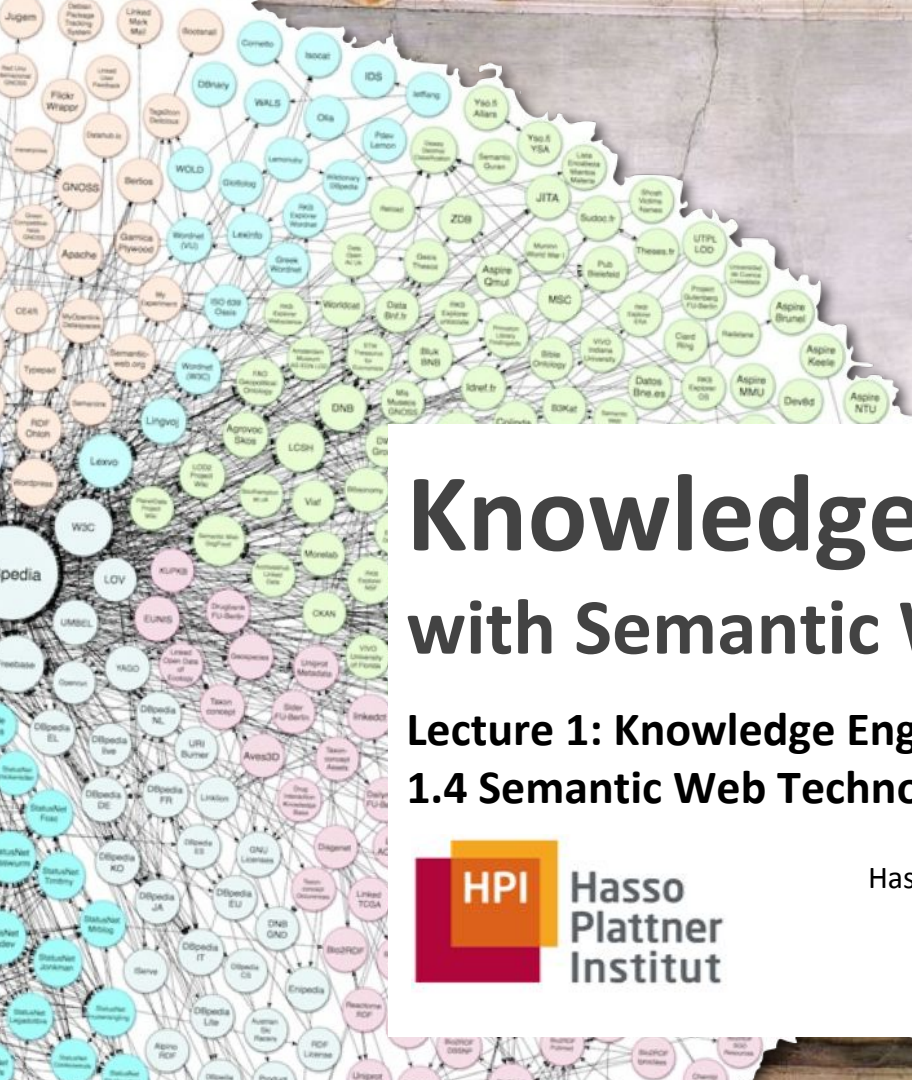




Knowledge Engineering with Semantic Web Technologies

Lecture 1: Knowledge Engineering and the Web of Data 1.4 Semantic Web Technology and the Web of Data



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University of Potsdam
Autumn 2015

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

Most apps use only a subset of the stack

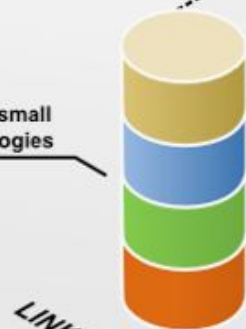
Querying allows fine-grained data access

Standardized information exchange is key

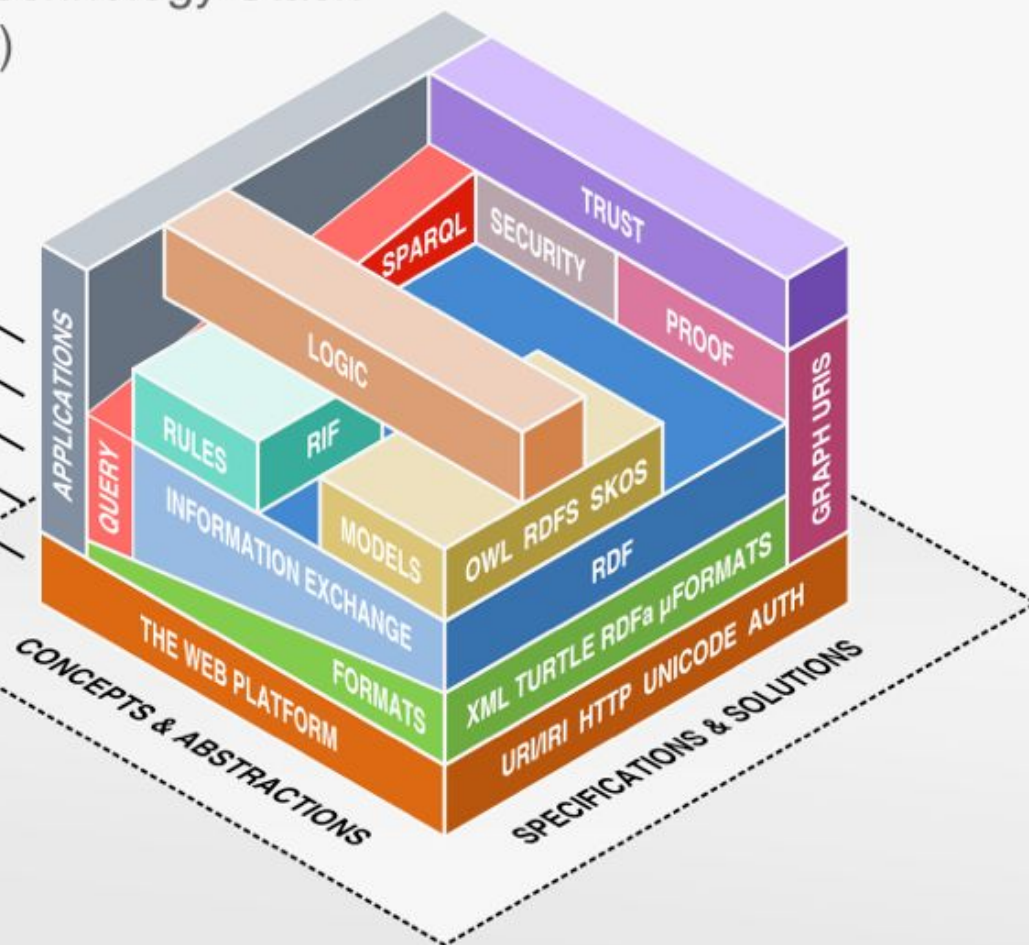
Formats are necessary, but not too important

The Semantic Web is based on the Web

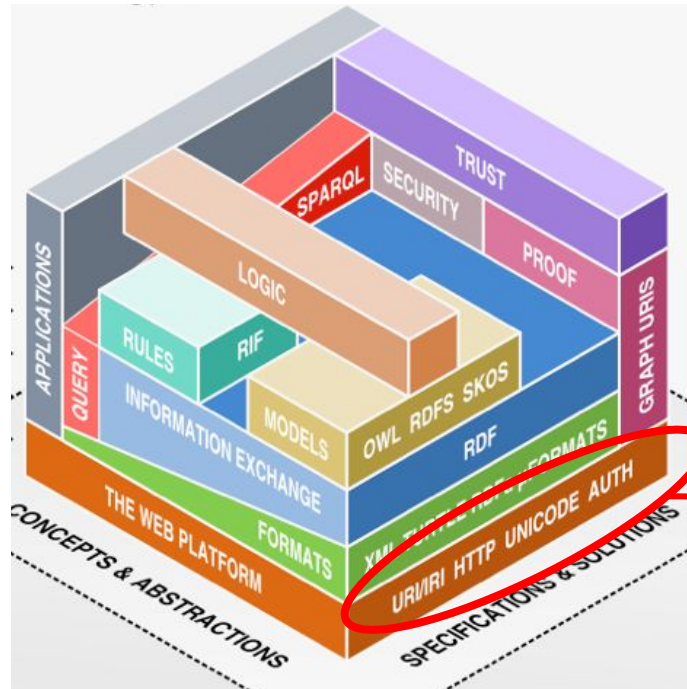
Linked Data uses a small selection of technologies



LINKED DATA



The Semantic Web Technology Stack



URI - Uniform Resource Identifier

Pluto

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

HPI Hasso Plattner Institut

Create account Log in

WIKIPEDIA
The Free Encyclopedia

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Bahasa Indonesia

Беларуская

Български

Босанска

Бразилски

Бурмански

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Pluto

From Wikipedia, the free encyclopedia

This article is about the dwarf planet. For other uses, see Pluto (disambiguation).

Pluto (minor-planet designation: **134340 Pluto**) is a dwarf planet in the Kuiper belt, a ring of bodies beyond Neptune. It was the first Kuiper belt object to be discovered, and is the largest and second-most-massive known dwarf planet in the Solar System and the ninth-largest and tenth-most-massive known object directly orbiting the Sun. It is the largest known trans-Neptunian object by volume but is less massive than Eris, a dwarf planet in the scattered disc. Like other Kuiper belt objects, Pluto is primarily made of ice and rock^[a] and is relatively small—about one-sixth the mass of the Moon and one-third its volume. It has a moderately eccentric and inclined orbit during which it ranges from 30 to 49 astronomical units or AU (4.4–7.3 billion km) from the Sun. This means that Pluto periodically comes closer to the Sun than Neptune, but a stable orbital resonance with Neptune prevents them from colliding. In 2014, Pluto was 32.6 AU from the Sun. Light from the Sun takes about 5.5 hours to reach Pluto at its average distance (39.4 AU).^[14]

Pluto was discovered in 1930 by Clyde Tombaugh, and was originally considered the ninth planet from the Sun. After 1992, its status as a planet fell into question following the discovery of several objects of similar size in the Kuiper belt. In 2005, Eris, which is 27% more massive than Pluto, was discovered, which led the International Astronomical Union (IAU) to define the term "planet" formally for the first time the following year.^[15] This definition excluded Pluto and reclassified it as a member of the new "dwarf planet" category (and specifically as a *plutoid*).^[17] Some astronomers think that Pluto, as well as the other dwarf planets, should be considered planets.^{[18][19][20]}

Pluto has five known moons: Charon (the largest, with a diameter just over half that of Pluto), Styx, Nix, Kerberos, and Hydra.^[21] Pluto and Charon are sometimes considered as officially classified as a moon of Pluto.^[22]

On 14 July 2015, the *New Horizons* spacecraft became the first spacecraft to fly by Pluto.^{[24][25][26]} During its brief flyby, *New Horizons* made detailed measurements and observations of Pluto and its moons.^[27]

Contents [hide]

1 History

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- 1.2 Name
- 1.3 Planet X disproved
- 1.4 Classification
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Pluto

Near-truth-colour image composite of Pluto taken by the *New Horizons* spacecraft on 14 July 2015 from a distance of 450,000 kilometers

Discovered by	Clyde W. Tombaugh
Discovery date	18 February 1930
Designations	
MPC designation	134340 Pluto
Pronunciation	/aɪˈpluːtoʊ/
Named after	Pluto
Minor planet category	Dwarf planet Trans-Neptunian object Plutoid Kuiper belt object Plutino
Adjectives	Plutonian
Orbital characteristics ^[14]	
Epoch J2000	
Aphelion	49.319 AU (7 311 000 000 km) (4 437 000 000 mi) (5 September 1989) ^[1]
Perihelion	29.656 AU (4 427 000 000 km) (2 748 000 000 mi) (5 September 1989) ^[1]
Semi-major axis	39.487 AU (5 874 000 000 km) (3 651 000 000 mi) 0.248 27
Eccentricity	0.157 072 ±0.000 001
Orbital period	247.94 years ^[2] 90 570 d±2 14 164.4 Plutonian solar days (5)
Synodic period	366.73 days ^[2]
Average orbital	4.67 km/s ^[2]



From Wikipedia to DBpedia

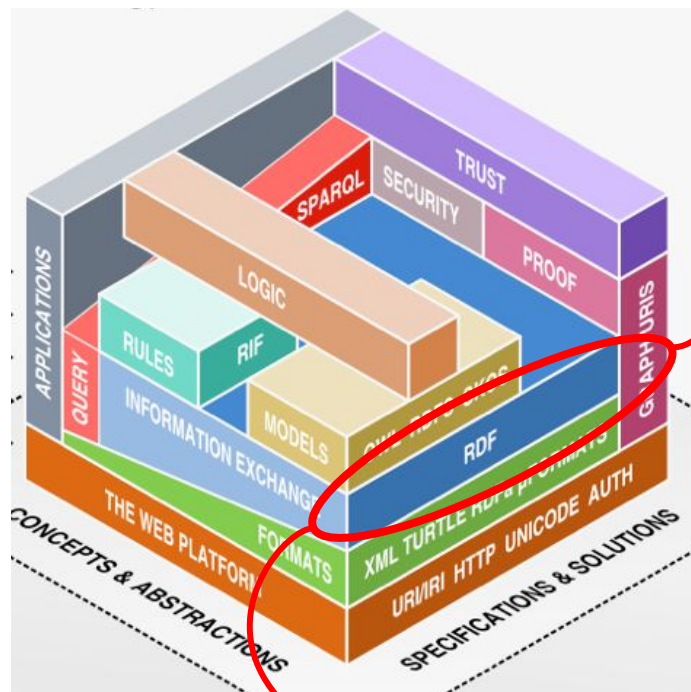


<http://dbpedia.org/resource/Pluto>

About:	Pluto
An Entity of Type :	planet , from Named Graph : http://dbpedia.org , within Data Space : dbpedia.org
	
Pluto (134340 Pluto) is the largest object in the Kuiper belt, the tenth-most-massive known body directly orbiting the Sun, and the second-most-massive known dwarf planet, after Eris. Like other Kuiper belt objects, Pluto is primarily made of rock and ice, and relatively small, about 1/6 the mass of the Moon and 1/3 its volume. It has an eccentric and highly inclined orbit that takes it from 30 to 49 AU (4.4–7.4 billion km) from the Sun.	
Property	Value
dbo:Planet/averageSpeed	• 4.7
dbo:Planet/maximumTemperature	• 55.0
dbo:Planet/meanRadius	• 1161.0
dbo:Planet/meanTemperature	• 44.0
dbo:Planet/minimumTemperature	• 33.0
dbo:Planet/periapsis	• 2.975501648223E11
dbo:abstract	- Pluto ist ein Zwergplanet und das prominenteste Objekt des Kuipergürtels. Er ist nach dem römischen Gott der Unterwelt benannt. Das astronomische Symbol des Pluto ist ♇. - August 2006 durch die Internationale Astronomische Union (IAU) galt er als der neunte und äußerste Planet des Sonnensystems. In der Folge wurde Pluto von der IAU mit dem Status eines Zwergplaneten abgestuft und als „Zwergplanet“ bezeichnet. Es ist geplant, die Sonde im Juli 2015 in 9800 Kilometern Entfernung an Pluto und in 27.000 Kilometern Entfernung an dessen Mond Charon vorbeizufahren zu lassen. - Pluto (134340 Pluto) is the largest object in the Kuiper belt, the tenth-most-massive known body directly orbiting the Sun, and the second-most-massive known dwarf planet, after Eris. Like other Kuiper belt objects, Pluto is primarily made of rock and ice, and relatively small, about 1/6 the mass of the Moon and 1/3 its volume. It has an eccentric and highly inclined orbit that takes it from 30 to 49 AU (4.4–7.4 billion km) from the Sun. - Pluto (134340 Pluto) is the largest object in the Kuiper belt, the tenth-most-massive known body directly orbiting the Sun, and the second-most-massive known dwarf planet, after Eris. Like other Kuiper belt objects, Pluto is primarily made of rock and ice, and relatively small, about 1/6 the mass of the Moon and 1/3 its volume. It has an eccentric and highly inclined orbit that takes it from 30 to 49 AU (4.4–7.4 billion km) from the Sun. - discovery of the minor planet Charon, numerous icy objects similar to Pluto with eccentric orbits were found. The scattered disc object Eris, discovered in 2005, is 27% more massive than Pluto (and specifically as a plutoid). Astronomers who oppose this decision hold that Pluto should have remained classified as a planet, and that other dwarf planets and even centaurs should also be considered planets. Pluto does not lie within either body. The IAU has yet to formalise a definition for binary dwarf planets, and Charon is officially classified as a moon of Pluto.On July 14, 2015, the Pluto system was designated 134340 Pluto.
dbo:albedo	• 0.490000 (xsd:double)
dbo:apparentMagnitude	• 13.650000 (xsd:double)
dbo:averageSpeed	• 16920.000000 (xsd:double)
dbo:discovered	• 1930-02-18 (xsd:date)
dbo:discoverer	• dbr:Clyde_Tombaugh
dbo:epoch	• J2000
dbo:maximumTemperature	• 55.000000 (xsd:double)
dbo:meanRadius	• 1161000.000000 (xsd:double)
dbo:meanTemperature	• 44.000000 (xsd:double)
dbo:minimunTemperature	• 33.000000 (xsd:double)
dbo:periapsis	• 297550164822300.000000 (xsd:double)
dbo:thumbnail	• http://commons.wikimedia.org/wiki/Special:FilePath/Pluto_symbol.svg?width=300
dbo:wikiPageExternalLink	http://ssd.jpl.nasa.gov/jsbdb_query.cgi?obj_group=all,obj_kind=all,obj_numbered=all,astr_orbit_class=TNO,OBJ_field=0;ORB_field=0;c1_group=ORB;c1_item=Bi;c1_op=s%3E;sort_by=obj_size&show_biblinks=yes http://www.mikebrownplanets.com/2010/11/how-big-is-pluto-anyway.html http://nssdc.gsfc.nasa.gov/planetary/factsheet/plutofact.html http://www.ifa.hawaii.edu/info/press-releases/PlutoPictures/Pluto-Tholen-10-07.html http://solarsystem.nasa.gov/planets/profile.cfm?Object=Pluto http://www.astronic.net/pressrelease/SOS5/sharpest-ever-views-of-pluto-and-charon http://www.sixtyymbols.com/videos/pluto.htm http://www.worldcat.org/search?q=isbn%3A3527405569 http://ssd.jpl.nasa.gov/horizons.cgi?fplnd_body=1&body_group=mb&sstr=9 http://ssd.jpl.nasa.gov/horizons.cgi?fplnd_body=1&body_group=mb&sstr=901 http://ssd.jpl.nasa.gov/horizons.cgi?fplnd_body=1&body_group=mb&sstr=999 http://solarsystem.nasa.gov/ http://www.lowell.edu/
dbo:wikiPageID	• 44469 (xsd:integer)
dbo:wikiPageRevisionID	• 645797094 (xsd:integer)
dbo:absMagnitude	• -0.7



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

```
:Pluto rdf:type dbo:Planet .  
: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 Tripel

:Pluto

RDF Subject

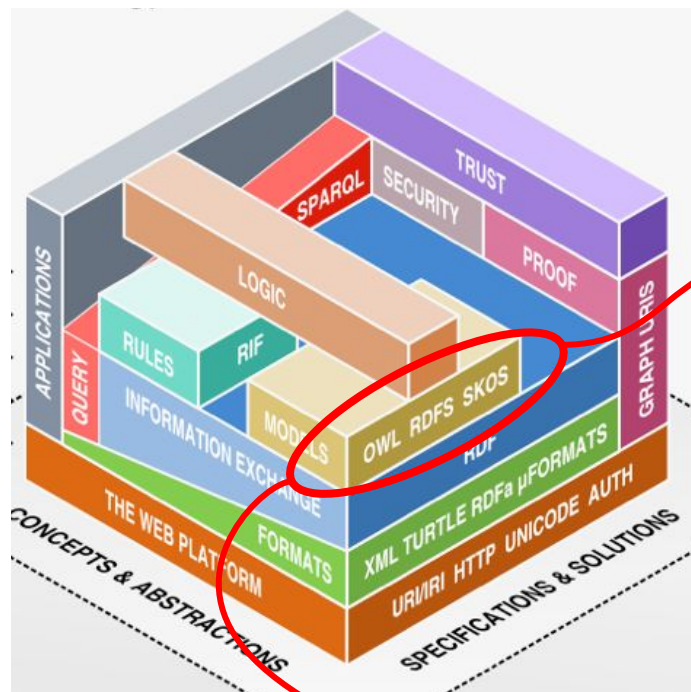
rdf:type

RDF Property

dbo:Planet .

RDF Object

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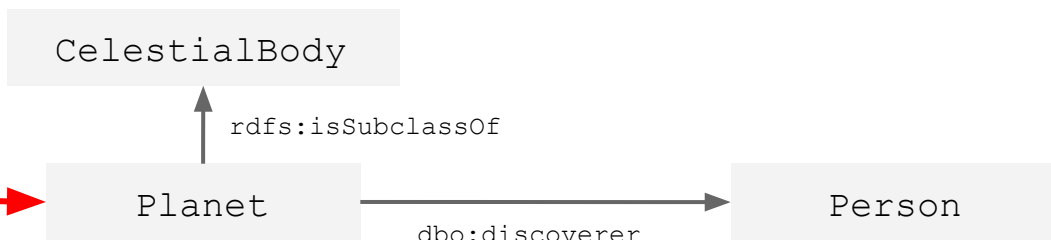


<http://dbpedia.org/ontology/Planet>

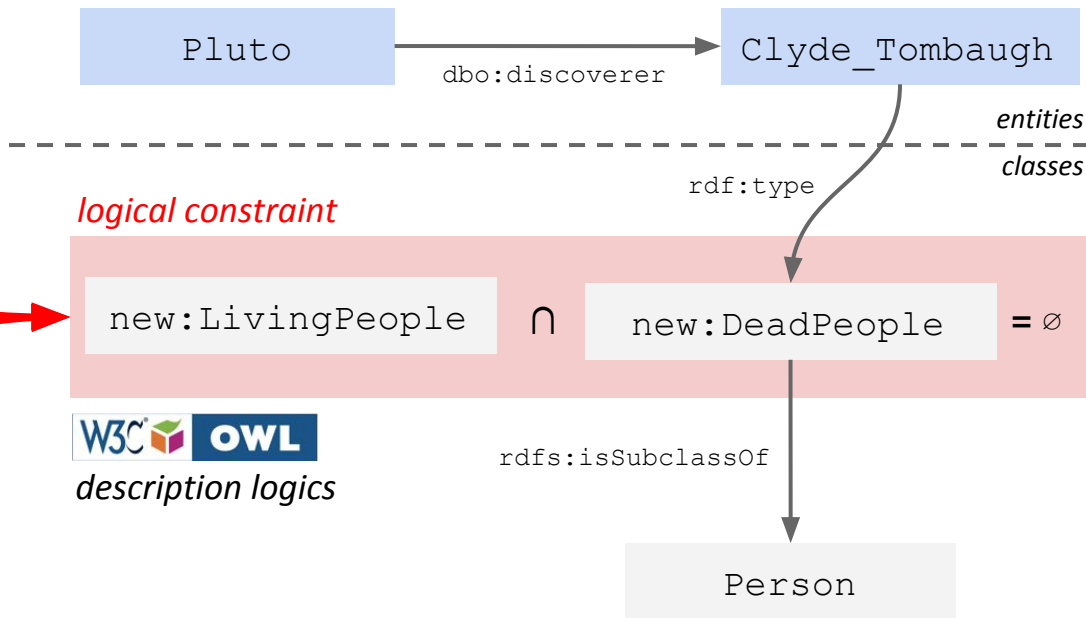
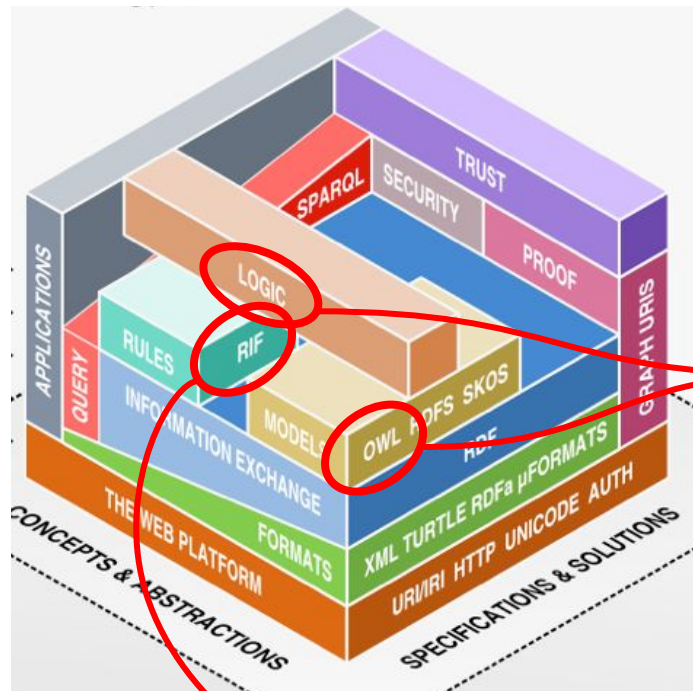
```
dbo:Planet rdf:type owl:class .
dbo:Planet rdfs:subClassOf dbo:CelestialBody .
dbo:discovered rdf:type rdf:Property .
dbo:discovered rdfs:domain owl:Thing .
dbo:discovered rdfs:range xsd:date .
dbo:discoverer rdf:type rdf:Property .
dbo:discoverer rdfs:domain owl:Thing .
dbo:discoverer rdfs:range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



RDF Schema



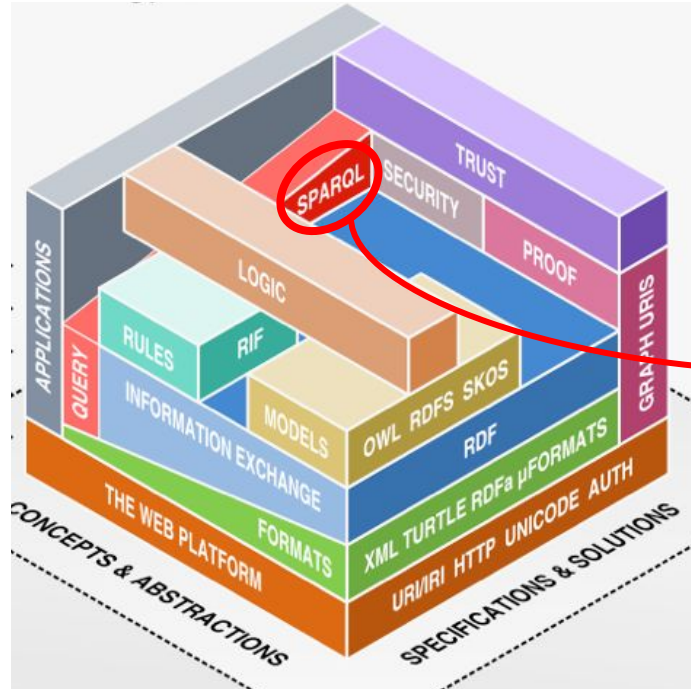
The Semantic Web Technology Stack



+ *logical rules*

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

The Semantic Web Technology Stack



Look for all **space missions in the Solar System** which have become a **satellite** of their target

```
PREFIX dcterms: <http://purl.org/dc/terms/>
```

```
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
```

```
PREFIX dbp: <http://dbpedia.org/property/>
```

```
PREFIX dbc: <http://dbpedia.org/resource/Category:>
```

```
SELECT distinct ?s ?o
```

```
FROM <http://dbpedia.org/>
```

```
WHERE{
```

```
?s dcterms:subject/skos:broader*
```

```
dbc:Discovery_and_exploration_of_the_Solar_System ;
```

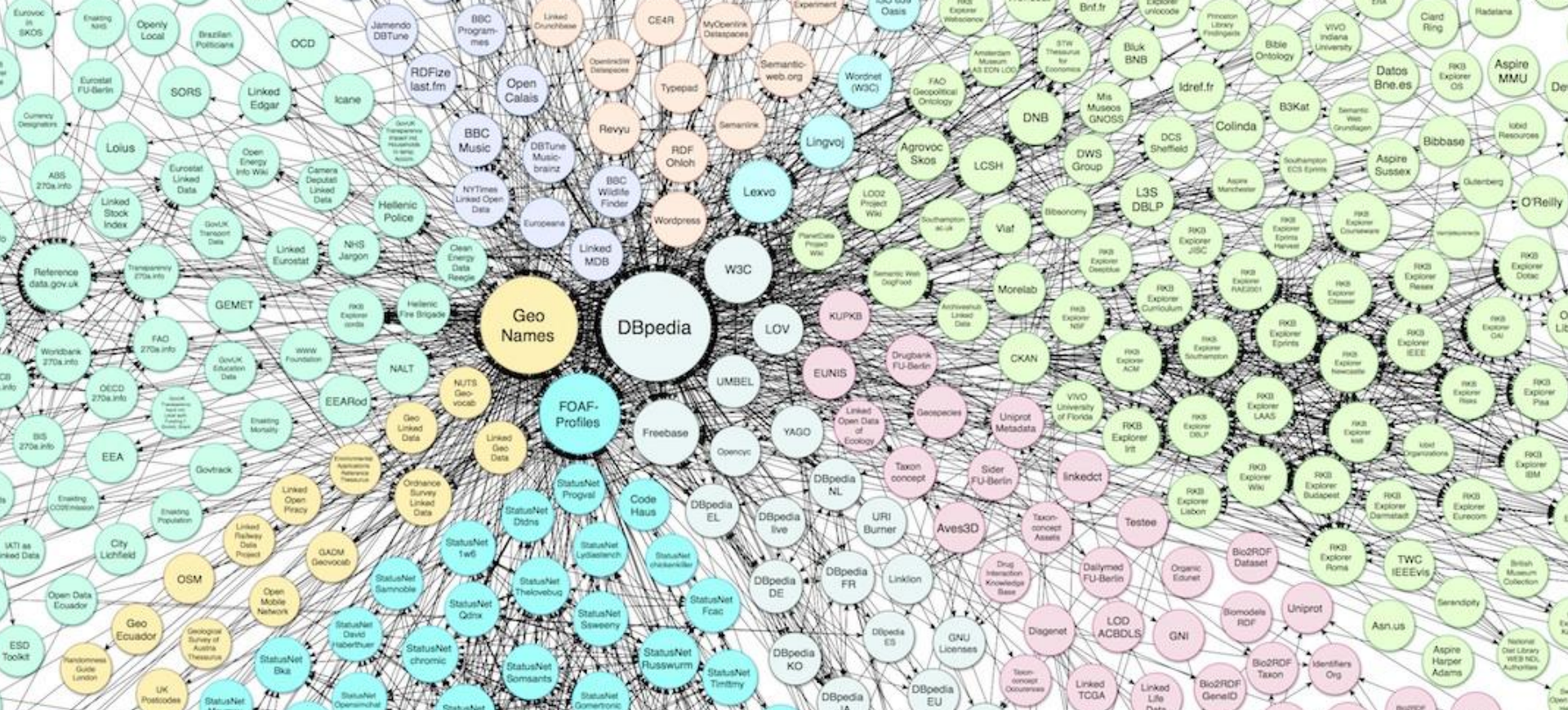
```
dbp:satelliteOf ?o .
```

```
}
```

Look for all space missions
in the Solar System
which have become
a satellite of their target

s	o
http://dbpedia.org/resource/Venera_13	http://dbpedia.org/resource/Venus
http://dbpedia.org/resource/Venera_14	http://dbpedia.org/resource/Venus
http://dbpedia.org/resource/Pioneer_6,_7,_8,_and_9	http://dbpedia.org/resource/Sun
http://dbpedia.org/resource/STEREO	"Sun"@en
http://dbpedia.org/resource/Huygens_(spacecraft)	"Saturn"@en
http://dbpedia.org/resource/Solar_Orbiter	"The Sun"@en
http://dbpedia.org/resource/Genesis_(spacecraft)	http://dbpedia.org/resource/Earth
http://dbpedia.org/resource/Genesis_(spacecraft)	http://dbpedia.org/resource/Lagrangian_point
http://dbpedia.org/resource/Genesis_(spacecraft)	http://dbpedia.org/resource/Sun
http://dbpedia.org/resource/Gravity_Recovery_and_Interior_Laboratory	http://dbpedia.org/resource/Moon
http://dbpedia.org/resource/Hiten	"Moon"@en
http://dbpedia.org/resource/Helios_(spacecraft)	http://dbpedia.org/resource/Sun
http://dbpedia.org/resource/SELENE-2	http://dbpedia.org/resource/Moon
http://dbpedia.org/resource/Venera_12	http://dbpedia.org/resource/Venus
http://dbpedia.org/resource/NEAR_Shoemaker	433
http://dbpedia.org/resource/Venera_10	http://dbpedia.org/resource/Venus
http://dbpedia.org/resource/Lunar-A	http://dbpedia.org/resource/Moon
http://dbpedia.org/resource/Suisei_(spacecraft)	"Sun"@en
http://dbpedia.org/resource/Ulysses_(spacecraft)	http://dbpedia.org/resource/Sun
http://dbpedia.org/resource/Viking_1	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/Viking_2	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/Luna_17	http://dbpedia.org/resource/Moon
http://dbpedia.org/resource/Luna_21	http://dbpedia.org/resource/Moon
http://dbpedia.org/resource/Mars_3	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/Venera_11	http://dbpedia.org/resource/Venus
http://dbpedia.org/resource/Nozomi_(spacecraft)	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/Phobos_program	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/Stardust_(spacecraft)	http://dbpedia.org/resource/Sun
http://dbpedia.org/resource/ExoMars_Trace_Gas_Orbiter	http://dbpedia.org/resource/Mars
http://dbpedia.org/resource/BepiColombo	"Mercury"@en

try SPARQL query at public DBpedia SPARQL endpoint



Next: 05 - How to Use the Web of Data

OpenHPI - Course Knowledge Engineering with Semantic Web Technologies

Lecture 1: Knowledge Engineering and the Web of Data