

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

Most apps use only a subset of the stack

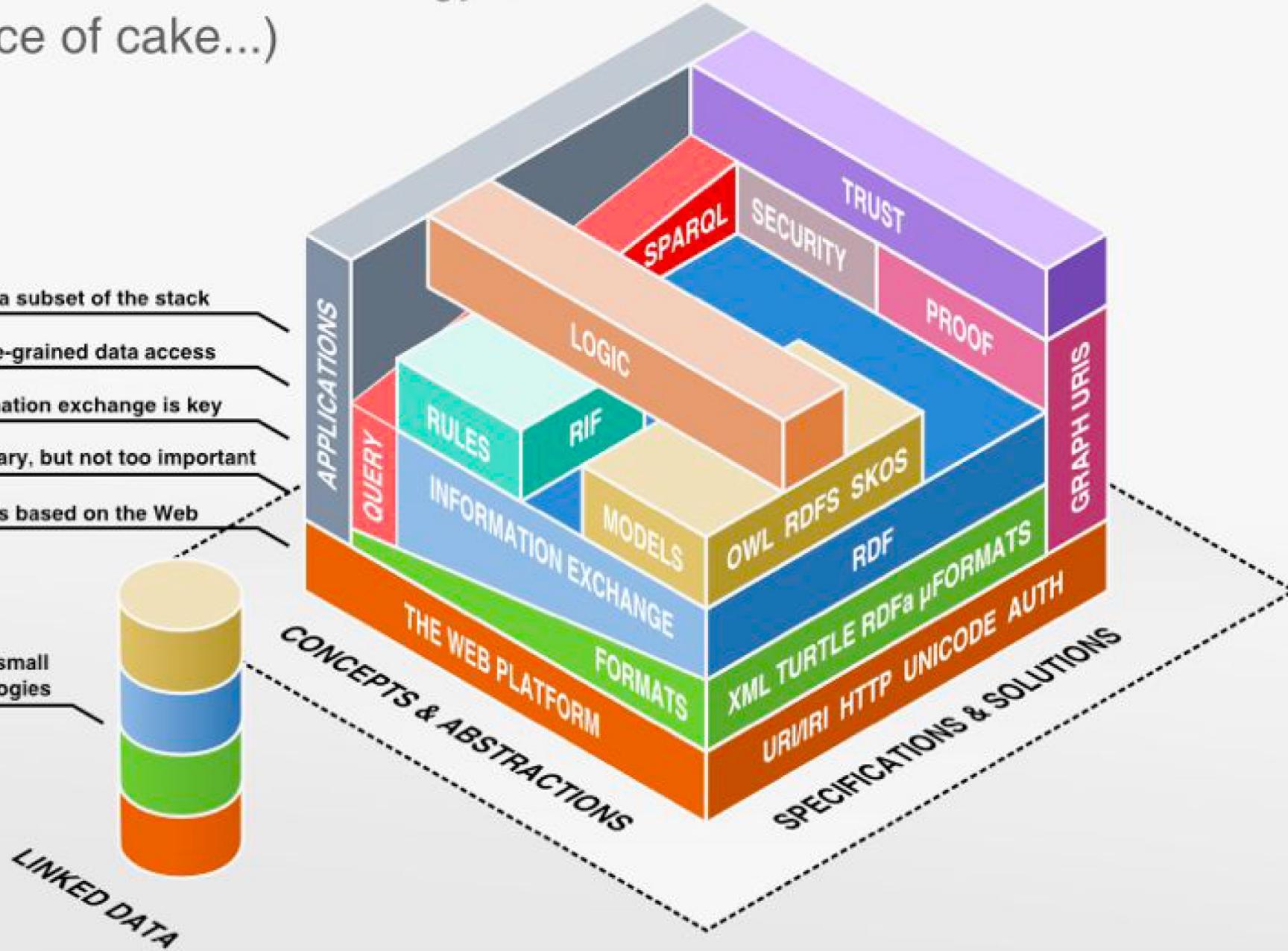
Querying allows fine-grained data access

Standardized information exchange is key

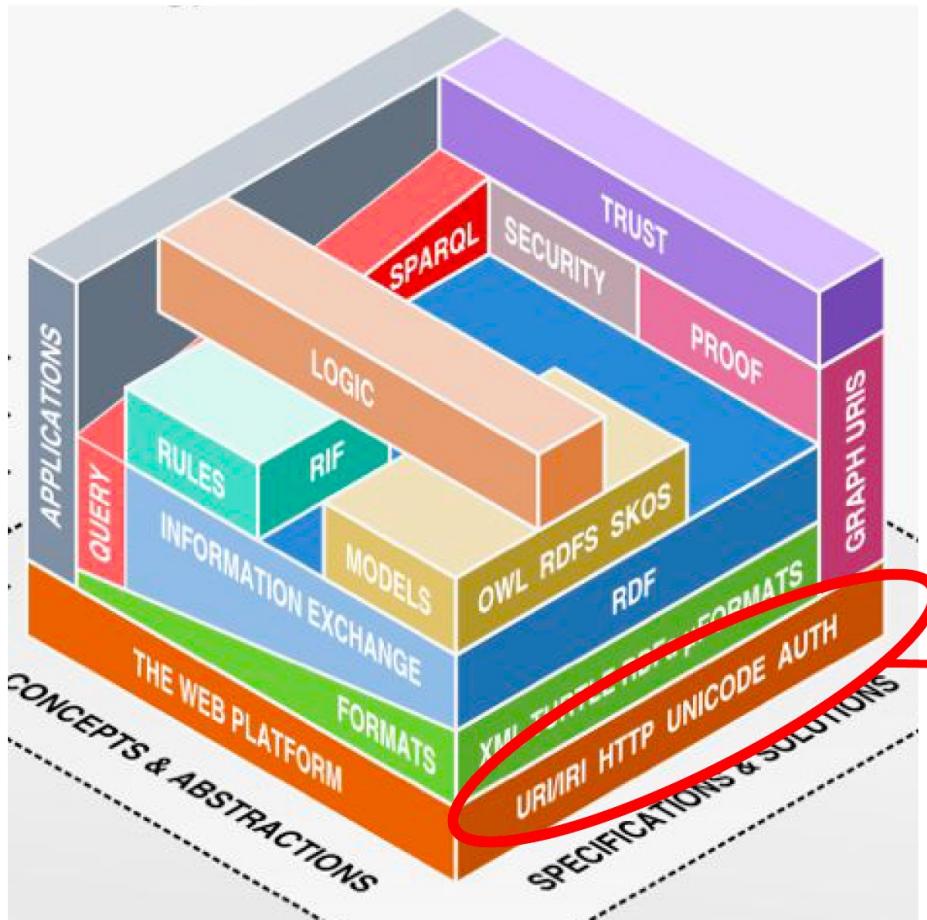
Formats are necessary, but not too important

The Semantic Web is based on the Web

Linked Data uses a small selection of technologies



The Semantic Web Technology Stack



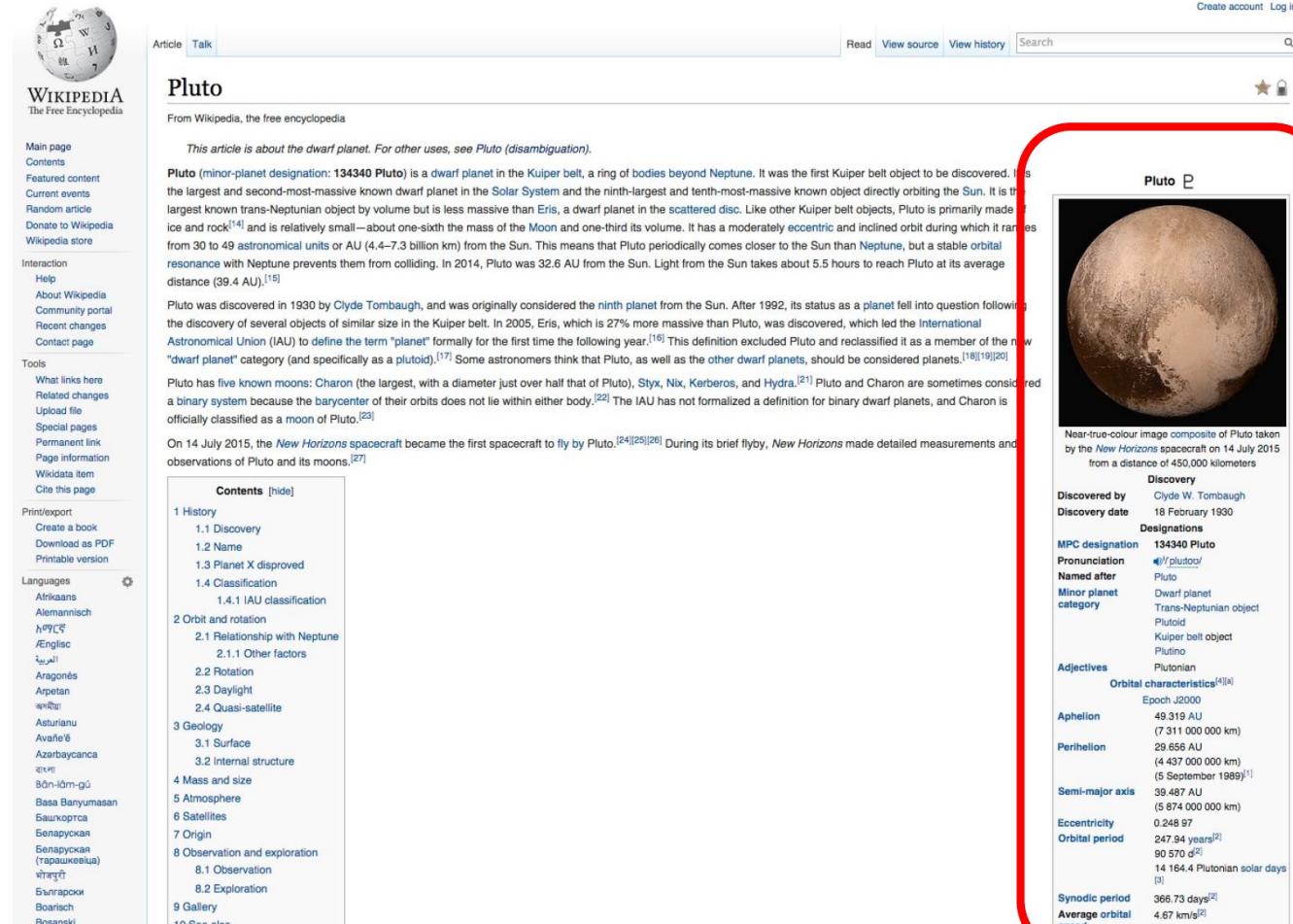
URI - Uniform Resource Identifier

Pluto

► <http://dbpedia.org/resource/Pluto>

From Wikipedia to DBpedia

<http://en.wikipedia.org/wiki/Pluto>



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The Free Encyclopedia

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Azərbaycanca
ഒറ്റി
Bóni-Jónm-gú
Baso Banyumasan
Башкортса
Беларуская
Беларуская (тарашкевіца)
ବାନ୍ଦାରୀ
Български
Borsich
Bosanski

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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. It 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^[14] 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).^[15]

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.^[16] 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 a binary system because the barycenter of their orbits does not lie within either body.^[22] The IAU has not formalized a definition for binary dwarf planets, and Charon is officially classified as a moon of Pluto.^[23]

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]

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Discovery
Discovered by Clyde W. Tombaugh
Discovery date 18 February 1930

Designations

MPC designation 134340 Pluto
Pronunciation /pluːtoʊs/
Named after Pluto

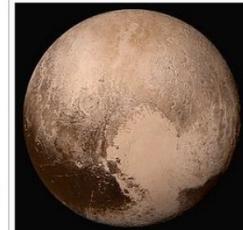
Minor planet category Dwarf planet
Trans-Neptunian object
Plutoid
Kuiper belt object
Plutino

Adjectives Plutonian

Orbital characteristics^{[4][4]}
Epoch J2000

Aphelion	49.319 AU (7 311 000 000 km)
Perihelion	29.656 AU (4 437 000 000 km) (5 September 1989) ^[5]
Semi-major axis	39.487 AU (5 874 000 000 km)
Eccentricity	0.248 97
Orbital period	247.94 years ^[2] 90 570 d ^[2] 14 164.4 Plutonian solar days ^[3]
Synodic period	366.73 days ^[2]
Average orbital speed	4.67 km/s ^[2]

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



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

 DBpedia

From Wikipedia to DBpedia

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

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About: Pluto

An Entity of Type : planet, from Named Graph : <http://dbpedia.org>, within Data Space : dbpedia.org

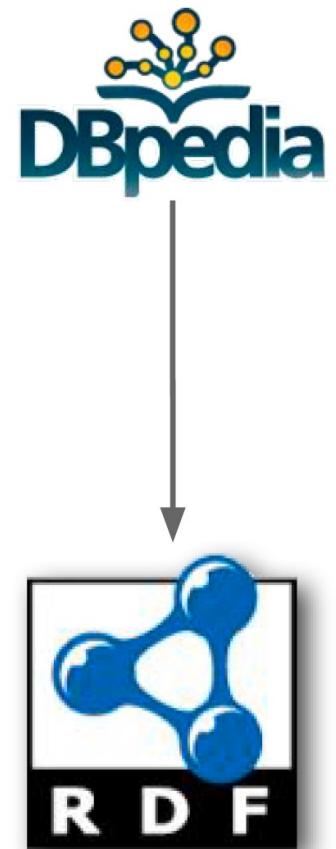
Pluto (minor-planet designation: 134340 Pluto) is a dwarf planet in the Kuiper belt, a ring of bodies beyond Neptune. It was the first Kuiper belt object to be discovered. It is the largest and second-most-massive known dwarf planet in the Solar System and the ninth-largest and tenth-most-massive known 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.

Property	Value
dbo:Planet/averageSpeed	▪ 4.67
dbo:Planet/maximumTemperature	▪ 55.0
dbo:Planet/meanTemperature	▪ 44.0
dbo:Planet/minimumTemperature	▪ 33.0
dbo:Planet/periapsis	▪ 7.479893535E8

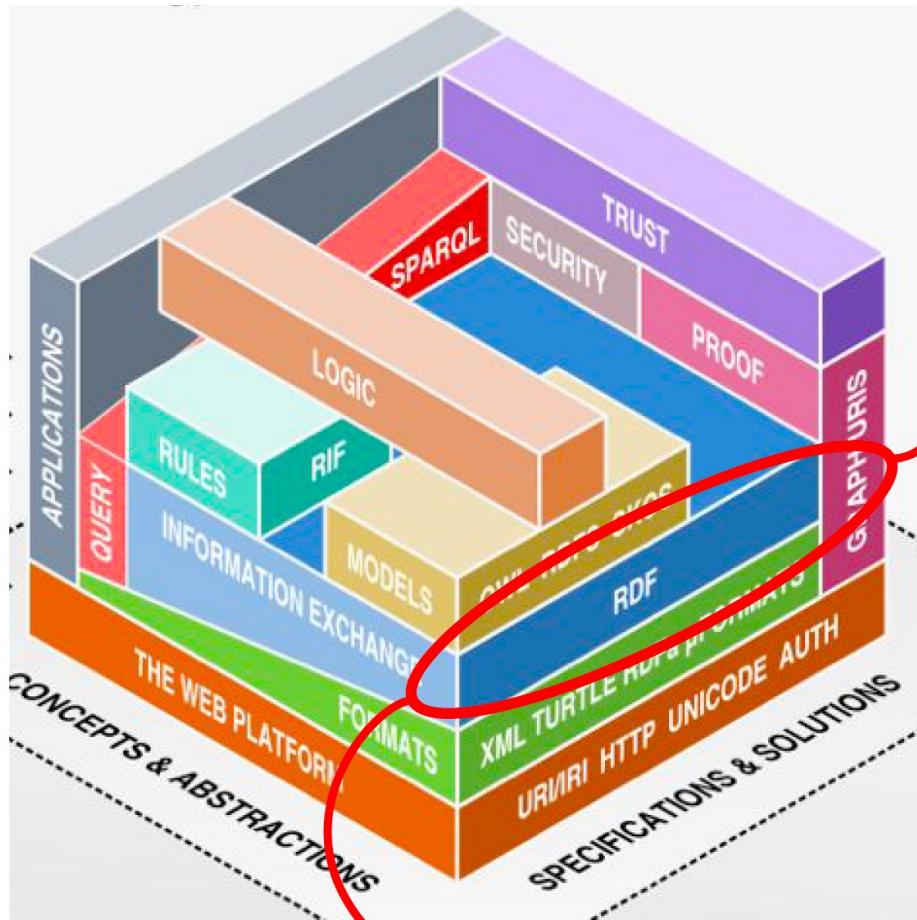
[dbo:abstract](#)

▪ Pluto ist der größte bekannte Zwergholz und ein prominentes Objekt des Kuipergürtels. Er ist nach dem römischen Gott der Unterwelt benannt. Das astronomische Symbol des Pluto ist Astronomisches Symbol des Pluto. In der Astrologie wird auch Astrologisches Symbol des Pluto verwendet. Pluto besitzt etwa ein Drittel des Volumens des Erdmondes und bewegt sich auf einer noch exzentrischeren Bahn um die Sonne als der Planet Merkur. Von seiner Entdeckung am 18. Februar 1930 bis zur Neudefinition des Begriffs „Planet“ am 24. August 2006 durch die Internationale Astronomische Union (IAU) galt Pluto als der neunte und äußerste Planet des Sonnensystems. Als immer neue, ähnlich große Körper im Kuipergürtel gefunden wurden (zum Beispiel (136199) Eris), wurde ihm der Planetenstatus aberkannt und er den Zwergholzen zugeordnet. In der Folge wurde Pluto von der IAU mit der Kleinpianetennummer 134340 versehen, sodass seine vollständige offizielle Bezeichnung nunmehr (134340) Pluto ist. Ferner wurden nach Pluto die neudefinierten Klassen der Plutoiden und der Plutinos benannt. Im Januar 2006 wurde mit New Horizons erstmals eine Raumsonde zu Pluto ausgesandt. Die Sonde flog am 14. Juli 2015 in 12500 km Entfernung an Pluto und in 28800 km Entfernung an dessen Mond Charon vorbei. (de)

▪ 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. It 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 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). 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. This definition excluded Pluto and reclassified it as a member of the new "dwarf planet" category (and specifically as a plutoid). Some astronomers think that Pluto and the other dwarf planets should be considered planets. Pluto has five known moons:



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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



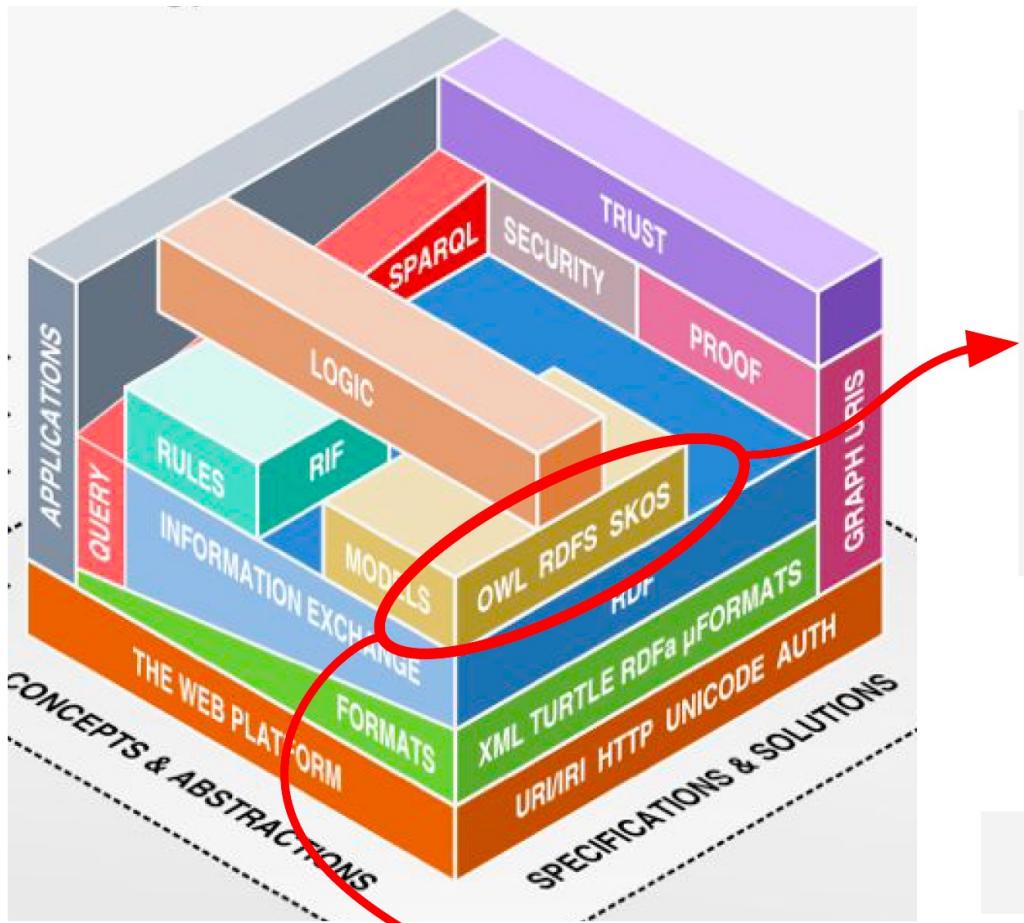
RDF Triple

: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 .  
...
```

W3C RDFS

RDF Schema

CelestialBody

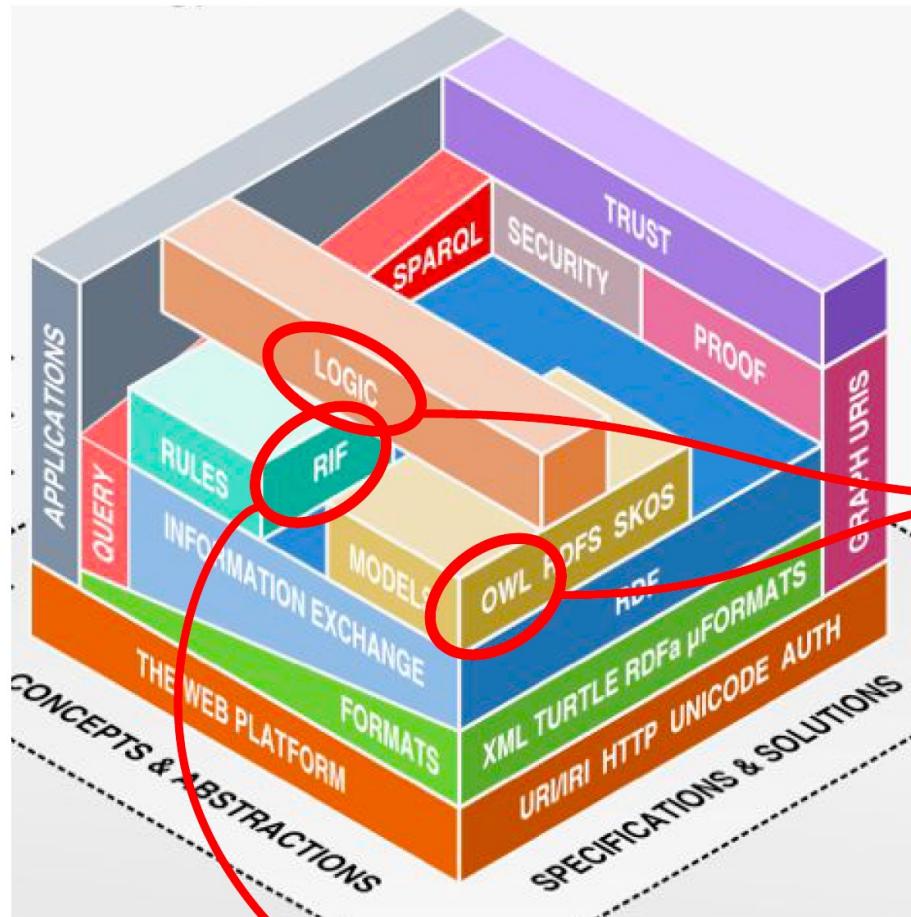
rdfs:subClassOf

Planet

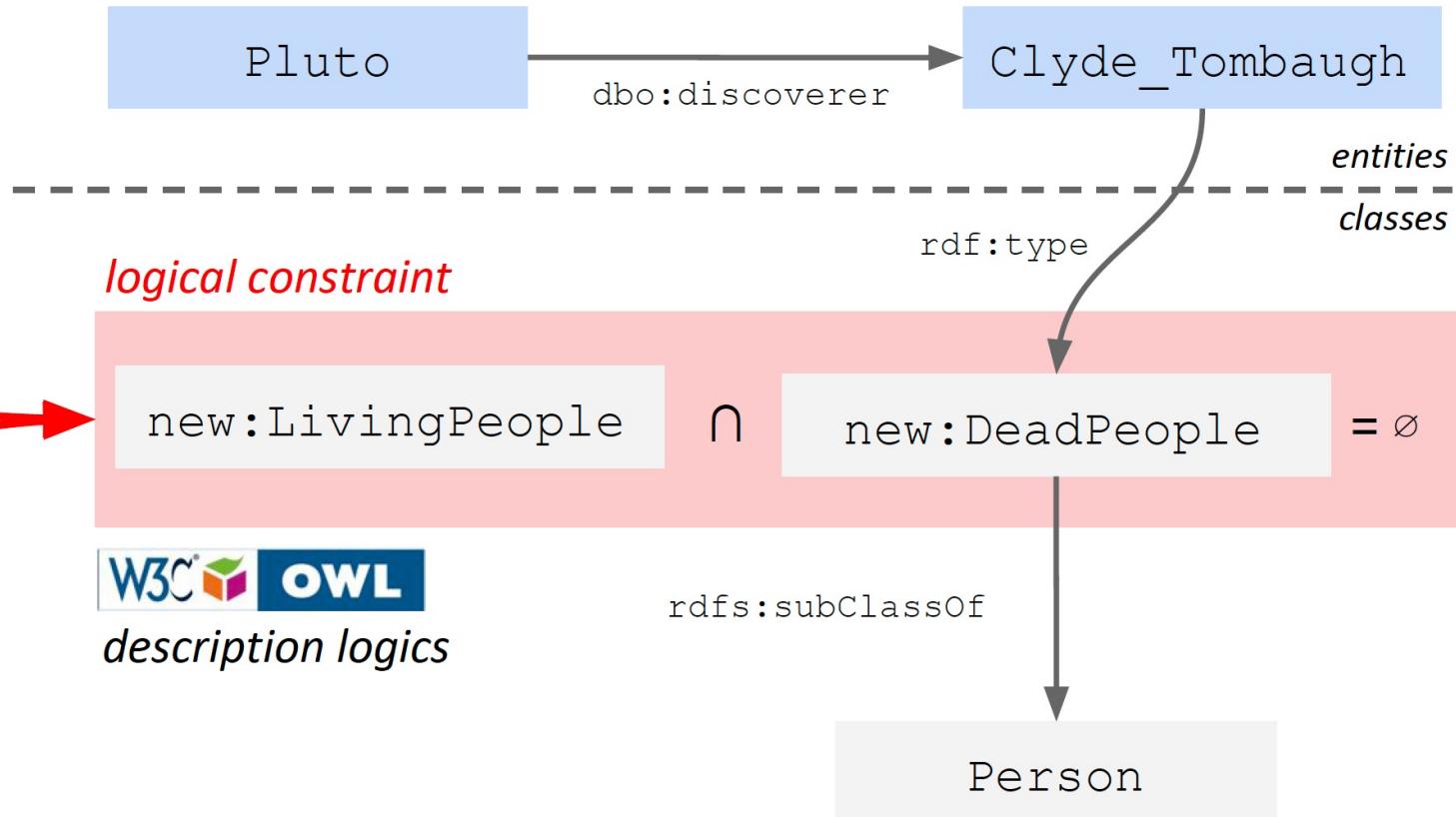
dbo:discoverer

Person

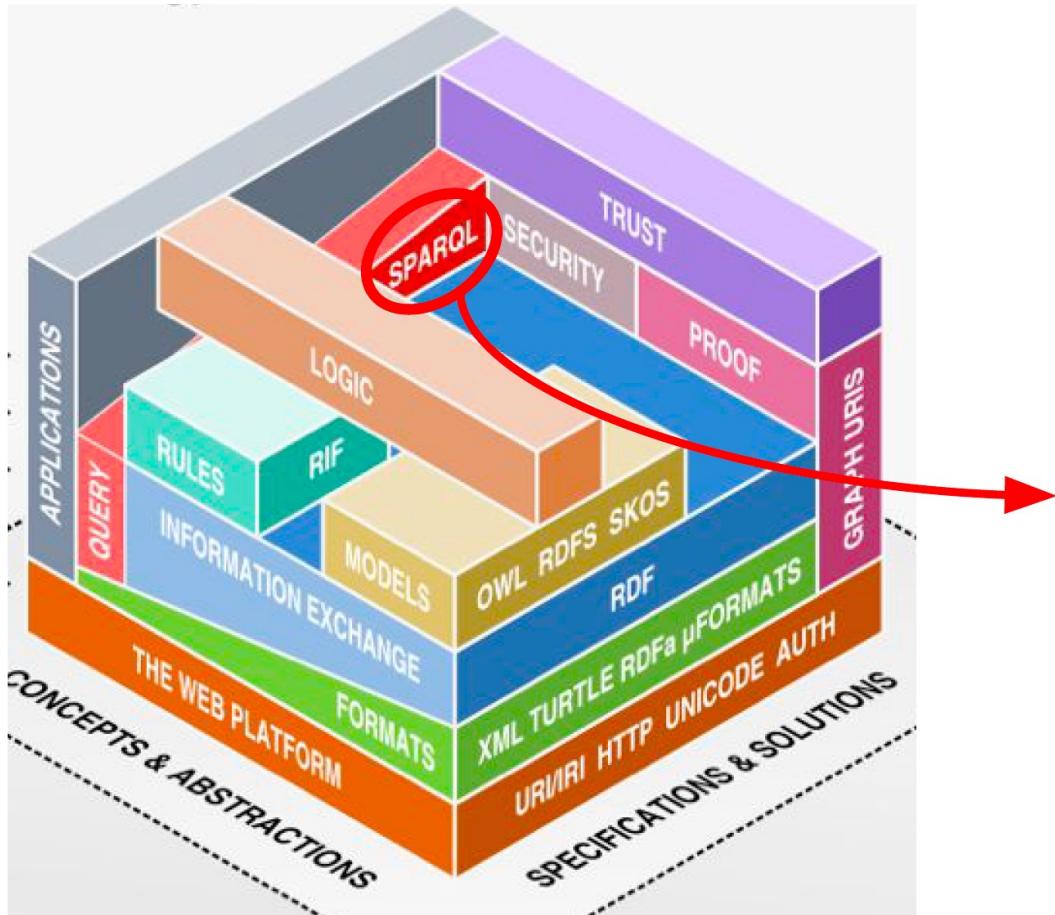
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+ logical rules

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


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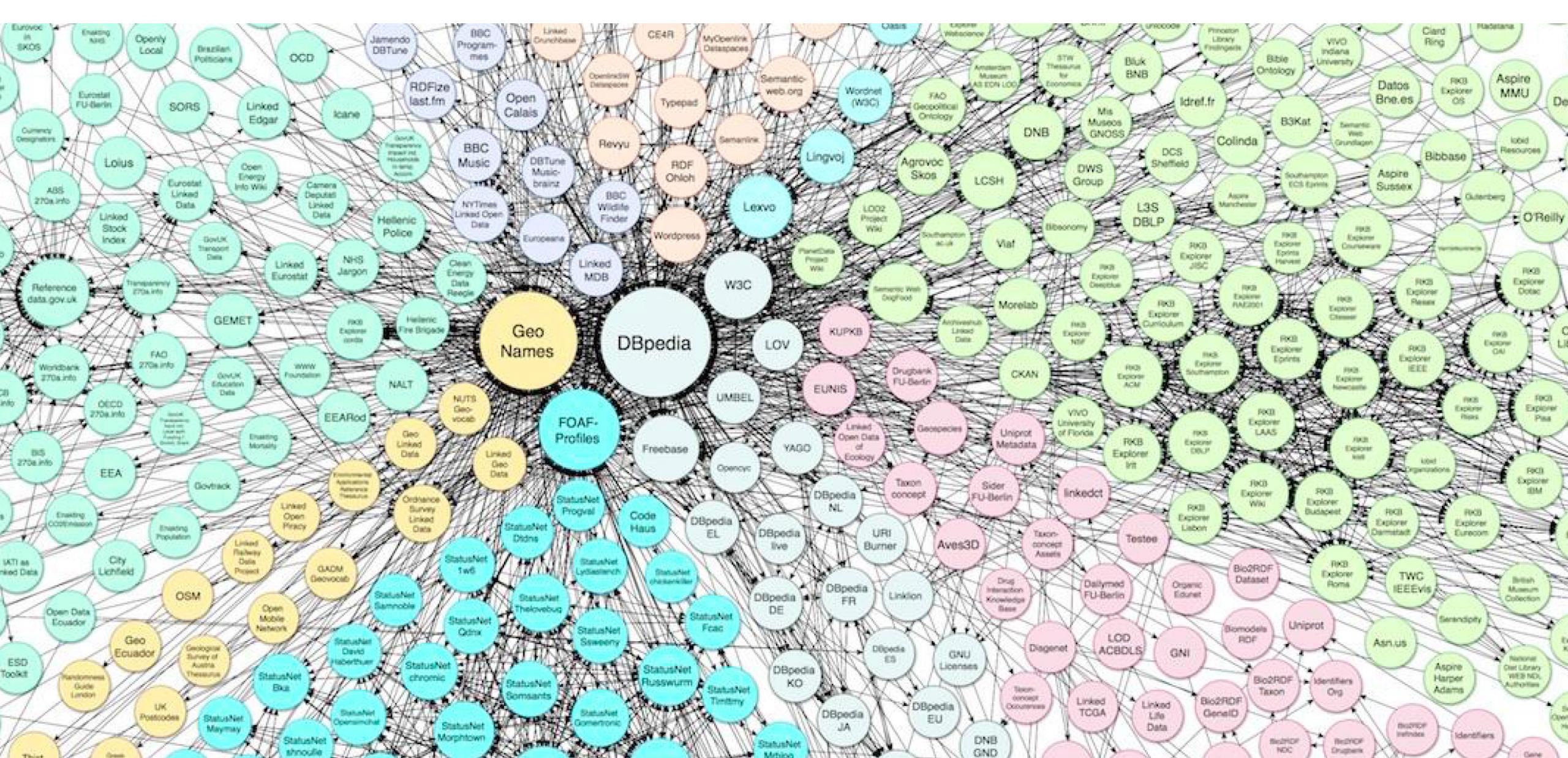
Look for all **space missions** in the Solar System which have become a **satellite** of their target

```
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)_2	http://dbpedia.org/resource/Lagrangian_point
http://dbpedia.org/resource/Genesis_(spacecraft)_3	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



Next: 05 - The Linked Data Principles