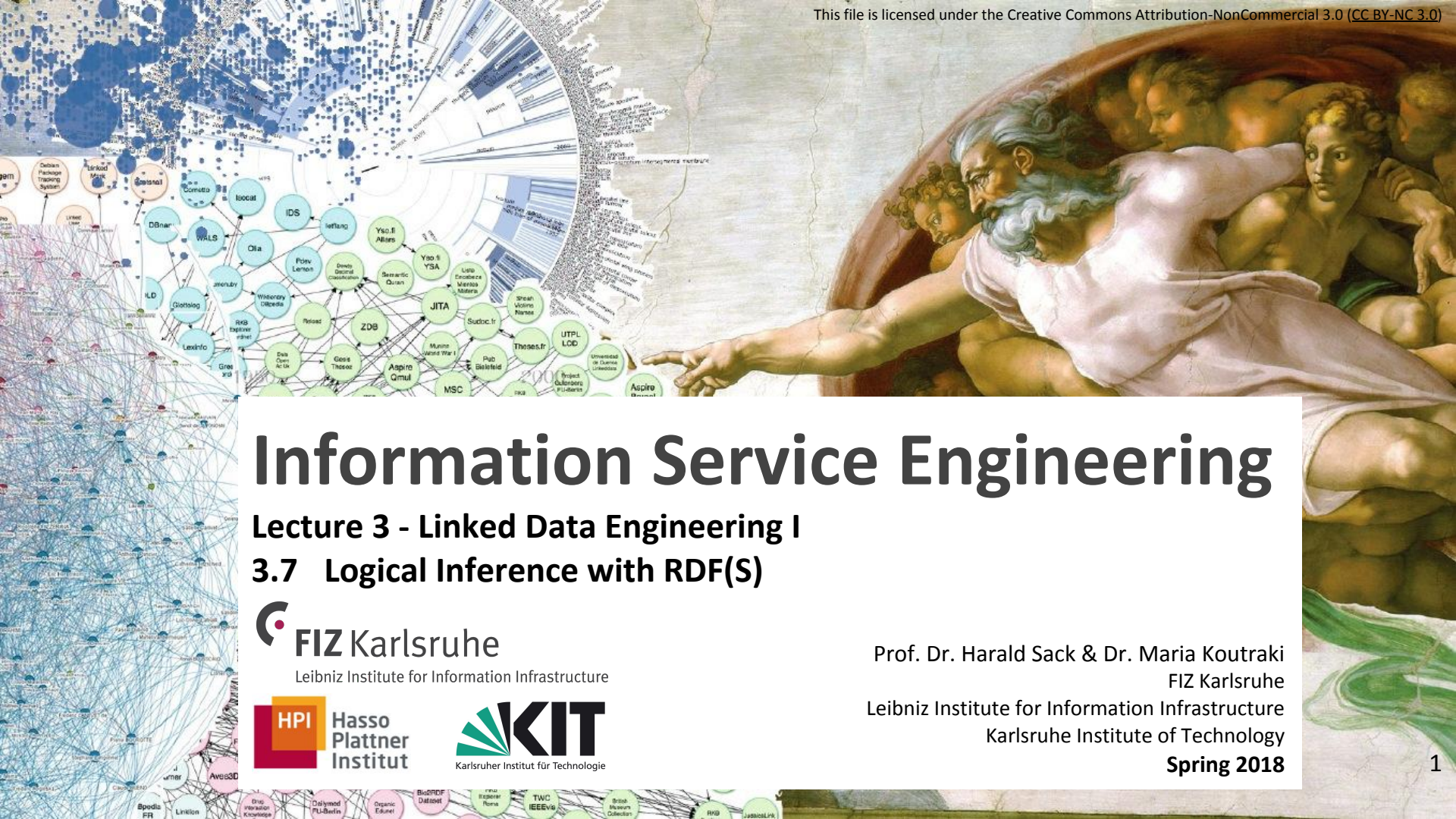




Information Service Engineering

Lecture 3 - Linked Data Engineering I

3.7 Logical Inference with RDF(S)



FIZ Karlsruhe

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Plattner
Institut



Karlsruher Institut für Technologie

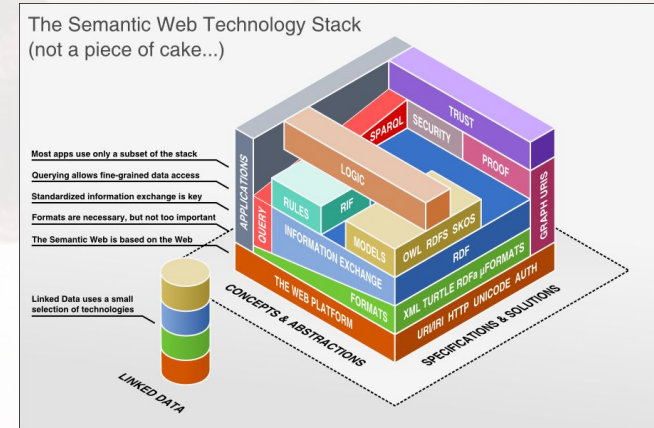
Prof. Dr. Harald Sack & Dr. Maria Koutraki
FIZ Karlsruhe

Leibniz Institute for Information Infrastructure
Karlsruhe Institute of Technology
Spring 2018

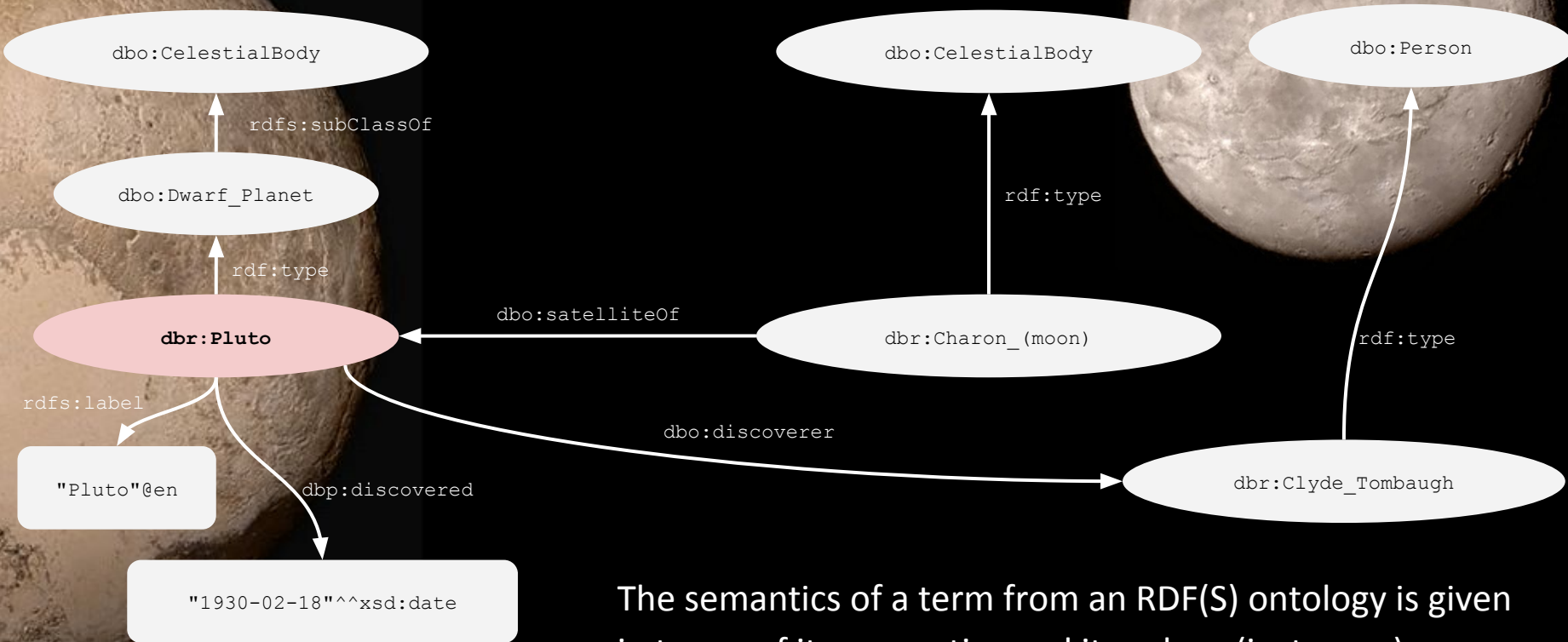
Information Service Engineering

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)**



How much knowledge (semantics) is there?



The semantics of a term from an RDF(S) ontology is given in terms of its properties and its values (instances)

RDF(S) Semantics

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- In difference to other data definition languages RDF(S) is based on a **formal semantics**
- Formal semantics enables RDF(S) to draw **valid** and **sound logical inferences**
- Examples:
 - `dbr:Pluto` `rdf:type` `dbo:Dwarf_Planet`
 - `dbo:Dwarf_Planet` `rdfs:subClassOf` `dbo:CelestialBody`
 - `dbo:artificialSatelliteOf` `rdfs:subPropertyOf` `dbo:satelliteOf`

`dbr:Pluto` $\in$ `dbo:Dwarf_Planet`
`dbo:Dwarf_Planet` $\subseteq$ `dbo:CelestialBody`
`dbo:artificialSatelliteOf` $\subseteq$ `dbo:satelliteOf`

Model-theoretic Semantics

Which Conclusions can we draw with RDF(S)?

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Which Conclusions can we draw with RDF(S)?

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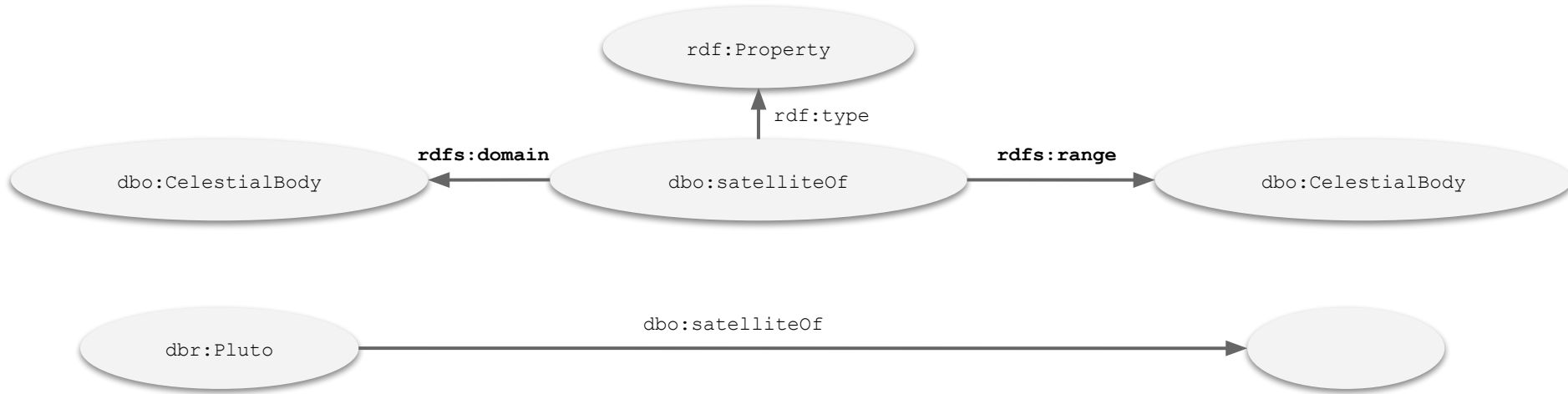


- Deduction of **new facts** from a **class hierarchy**.

$$\forall i, c_1, c_2: T(i, \text{rdf:type}, c_1) \wedge T(c_1, \text{rdfs:subClassOf}, c_2) \rightarrow T(i, \text{rdf:type}, c_2)$$

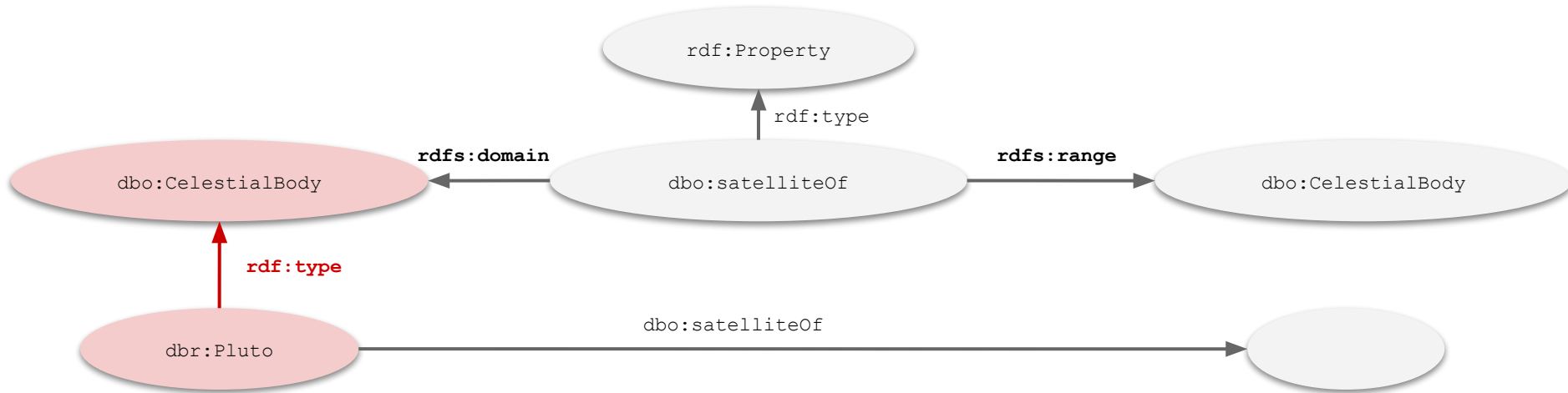
Which Conclusions can we draw with RDF(S)?

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Which Conclusions can we draw with RDF(S)?

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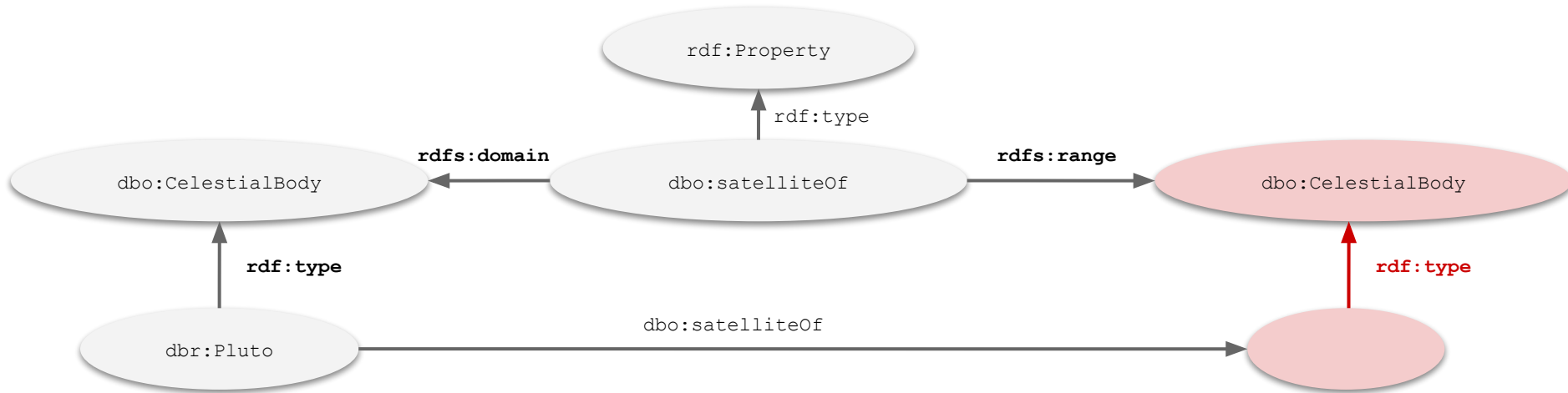


- Deduction of entity **class membership** from the **domain** of one of its properties

$$\begin{aligned} \forall i_1, i_2, c_1, c_2, p: \quad & T(i_1, p, i_2) \wedge \\ & T(p, \text{rdfs:domain}, c_1) \wedge T(p, \text{rdfs:range}, c_2) \\ \rightarrow & T(i_1, \text{rdf:type}, c_1) \wedge T(i_2, \text{rdf:type}, c_2) \end{aligned}$$

Which Conclusions can we draw with RDF(S)?

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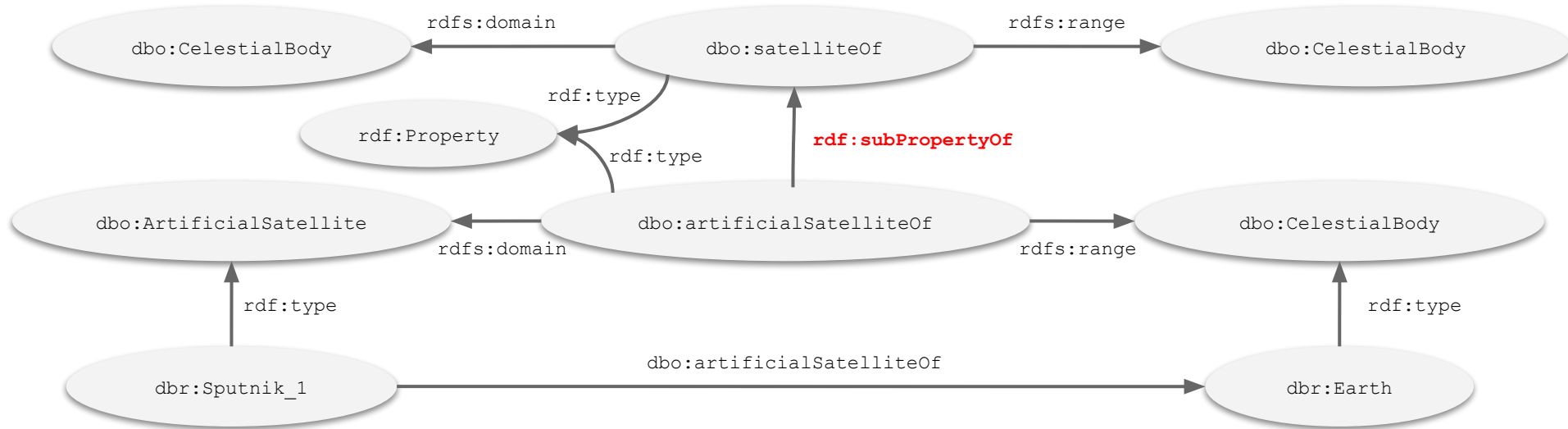


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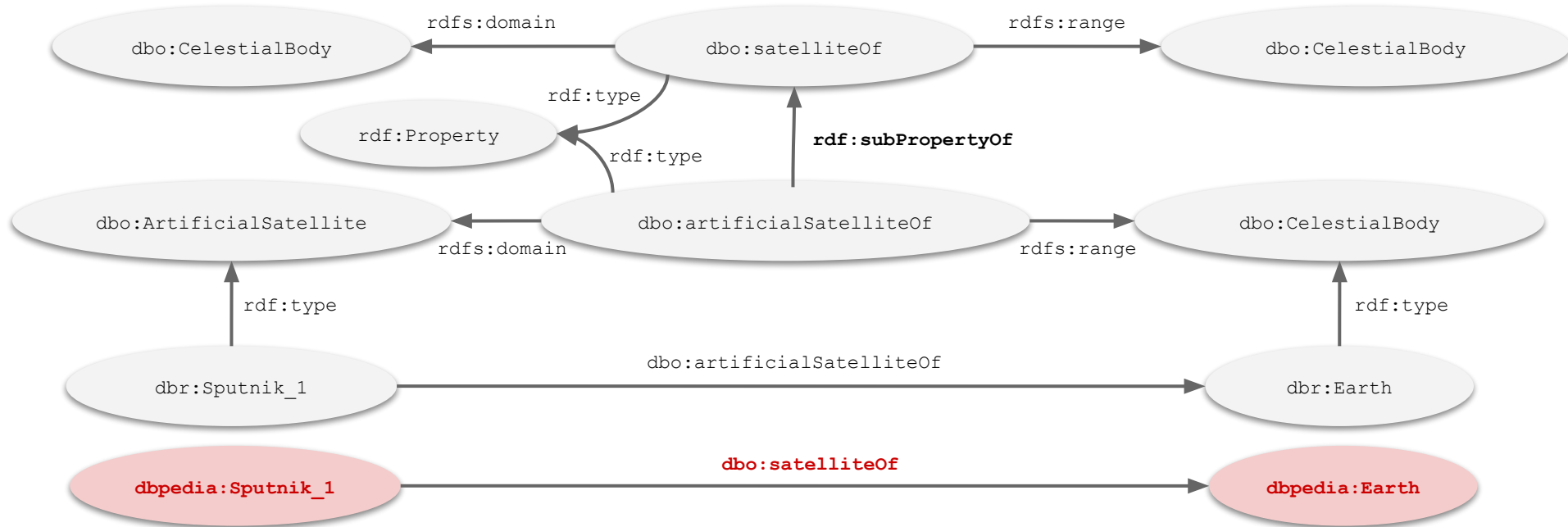
Which Conclusions can we draw with RDF(S)?

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Which Conclusions can we draw with RDF(S)?

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- Deduction of **new facts** from **subproperty** relationships

$$\forall i_1, i_2, p_1, p_2: T(i_1, p_1, i_2) \wedge T(p_1, \text{rdfs:subPropertyOf}, p_2) \rightarrow T(i_1, p_2, i_2)$$

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

Most apps use only a subset of the stack

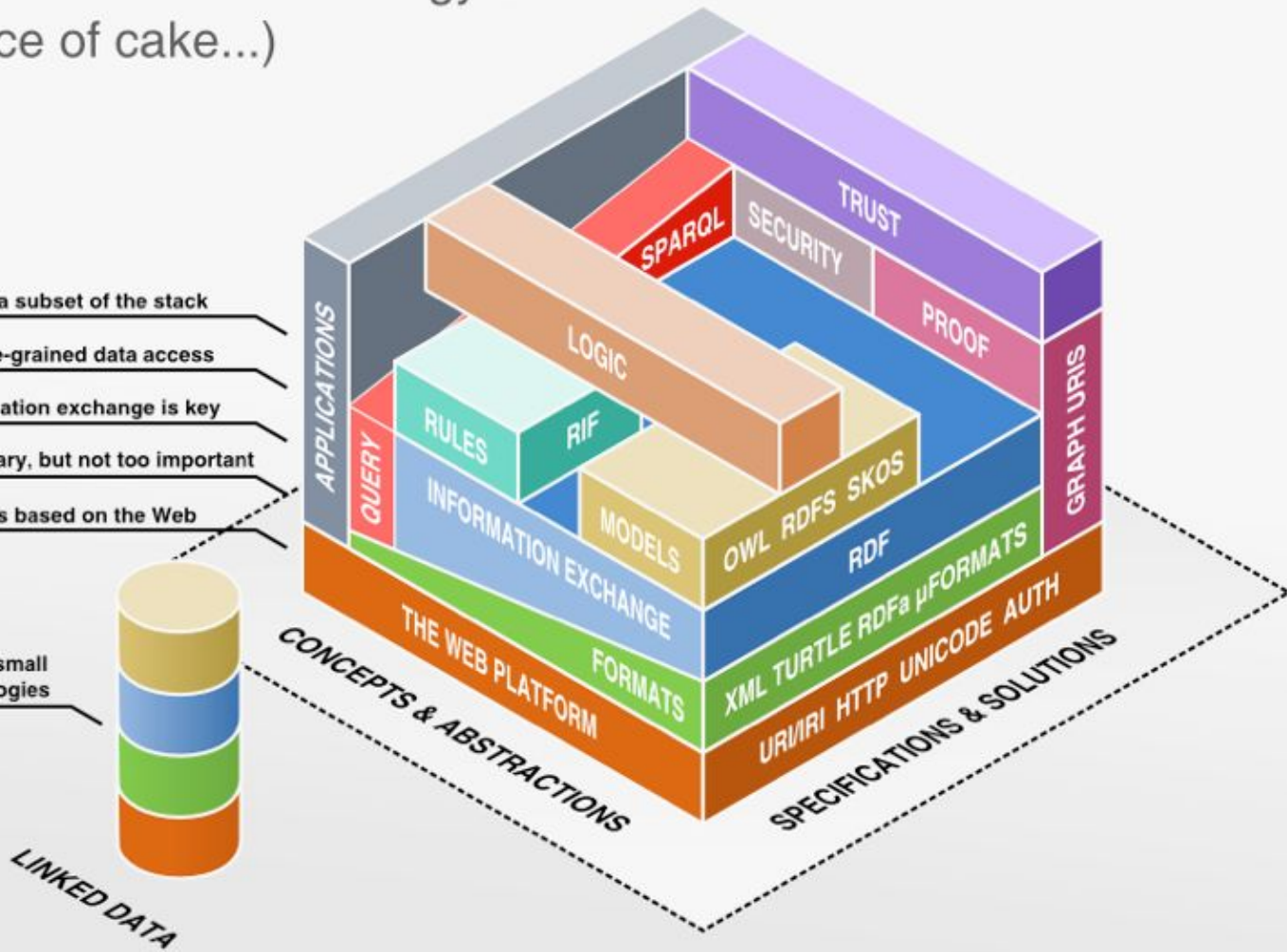
Querying allows fine-grained data access

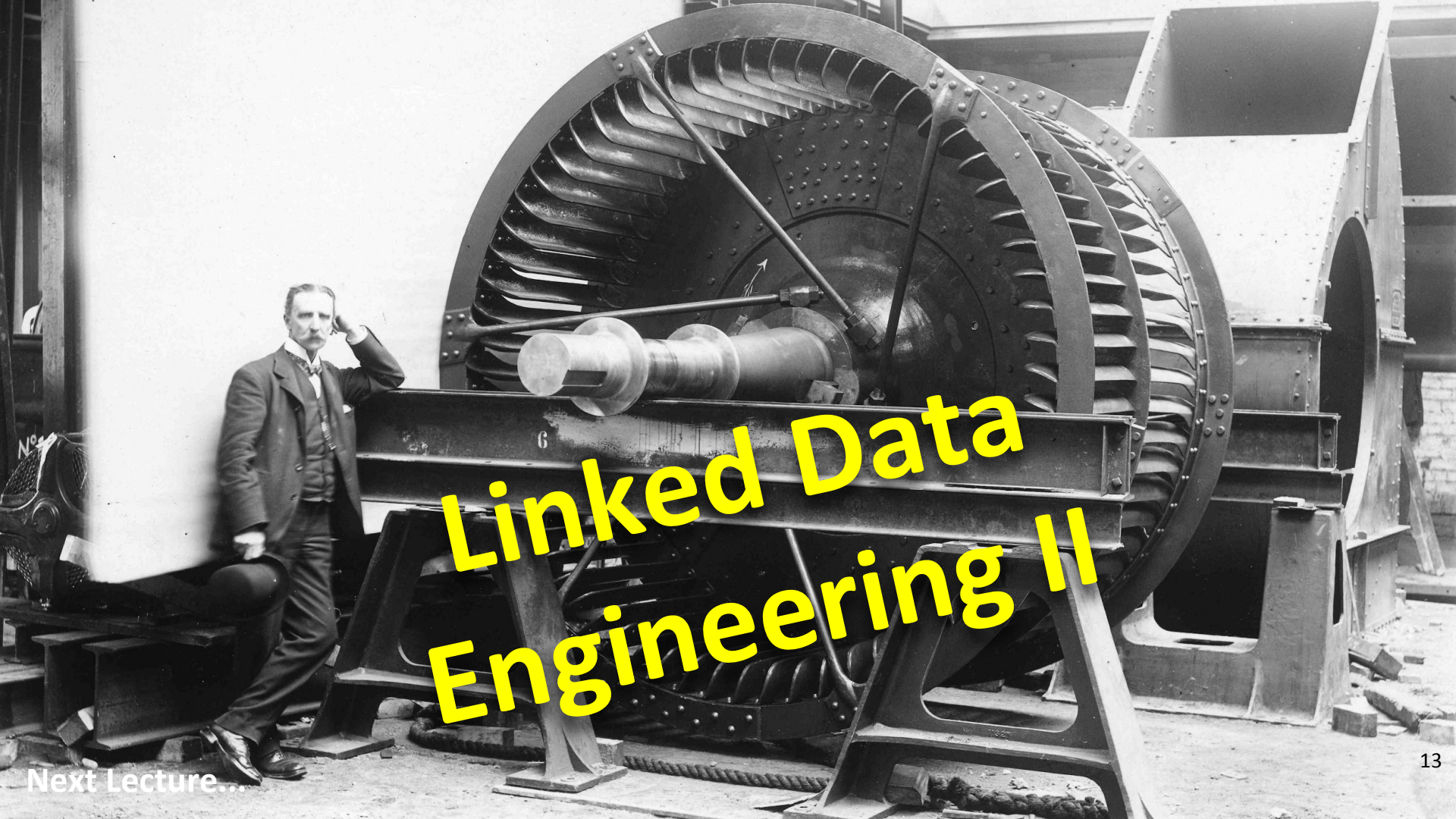
Standardized information exchange is key

Formats are necessary, but not too important

The Semantic Web is based on the Web

Linked Data uses a small
selection of technologies





Next Lecture...

Picture References:

- P.3: Pluto and Charon, NASA, <https://www.nasa.gov/feature/pluto-s-big-moon-charon-reveals-a-colorful-and-violent-history>
The astronomer Clyde Tombaugh, discoverer of Pluto here shown with his homemade 9-inch telescope. (1930)
[https://commons.wikimedia.org/wiki/File:Clyde W. Tombaugh.jpeg](https://commons.wikimedia.org/wiki/File:Clyde_W._Tombaugh.jpeg)
- P.13: (Peter Bleakley), Samuel Cleland Davidson with a huge centrifugal fan he designed and manufactured, probably for ventilating a mine shaft, at the Sirocco Engineering Works, Belfast. This is a scan of a family photo in the Bleakley Family archive owned by the copyright holder.
[https://commons.wikimedia.org/wiki/File:Samuel Cleland Davidson with a centrifugal fan at the Sirocco Engineering Works, Belfast.jpg](https://commons.wikimedia.org/wiki/File:Samuel_Cleland_Davidson_with_a_centrifugal_fan_at_the_Sirocco_Engineering_Works,_Belfast.jpg)