

Knowledge Graphs

Lecture 2 - Basic Semantic Technologies

2.4 RDF Complex Data Structures

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Leibniz-Institut für Informationsinfrastruktur

Knowledge Graphs

Lecture 2: Basic Semantic Technologies

2.1 How to Identify and Access Things

2.2 How to Represent Simple Facts with RDF

2.3 RDF Turtle Serialization

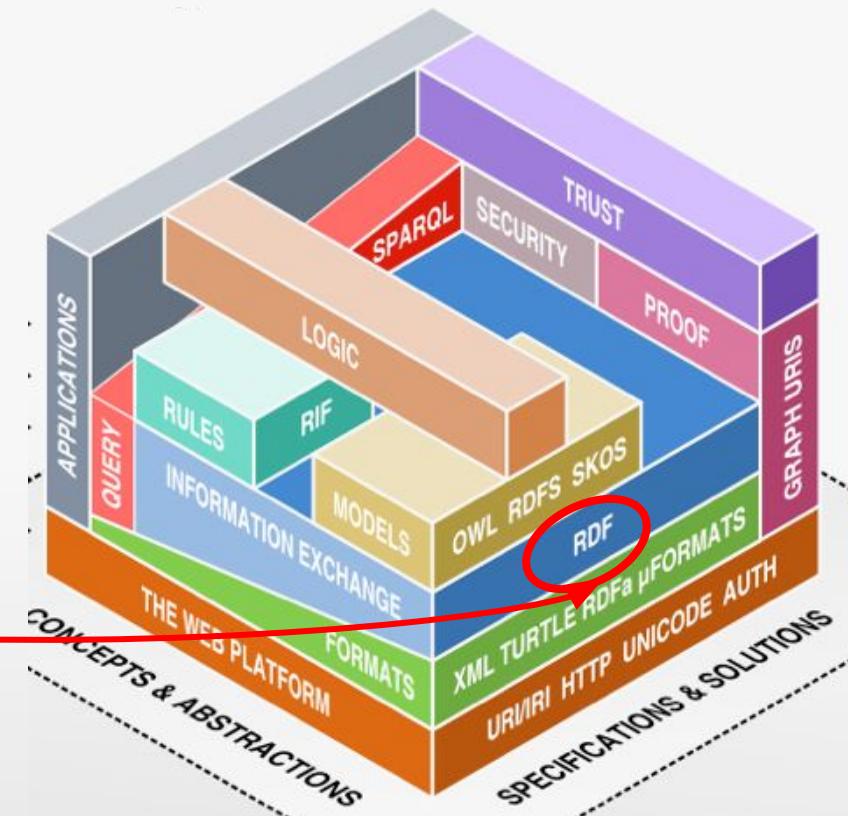
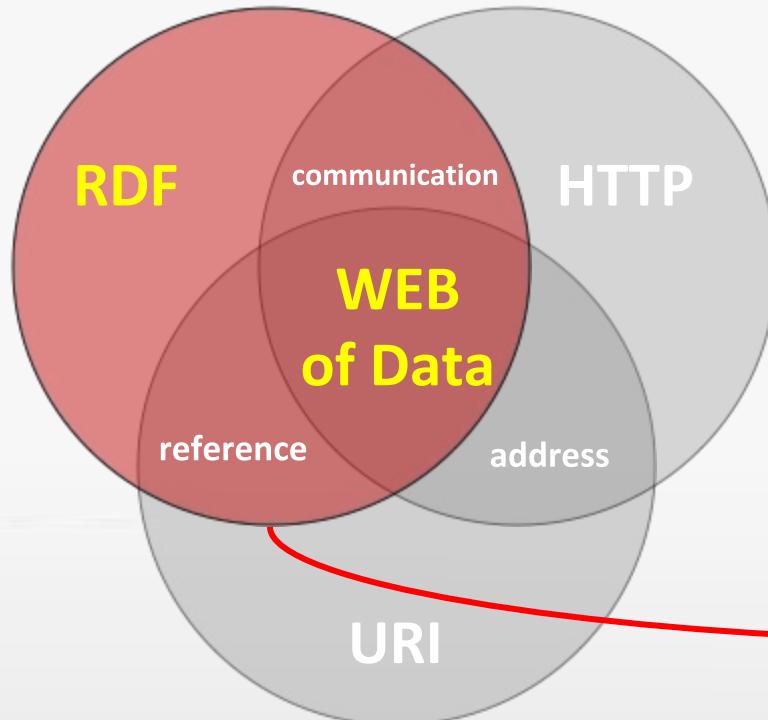
2.4 RDF Complex Data Structures

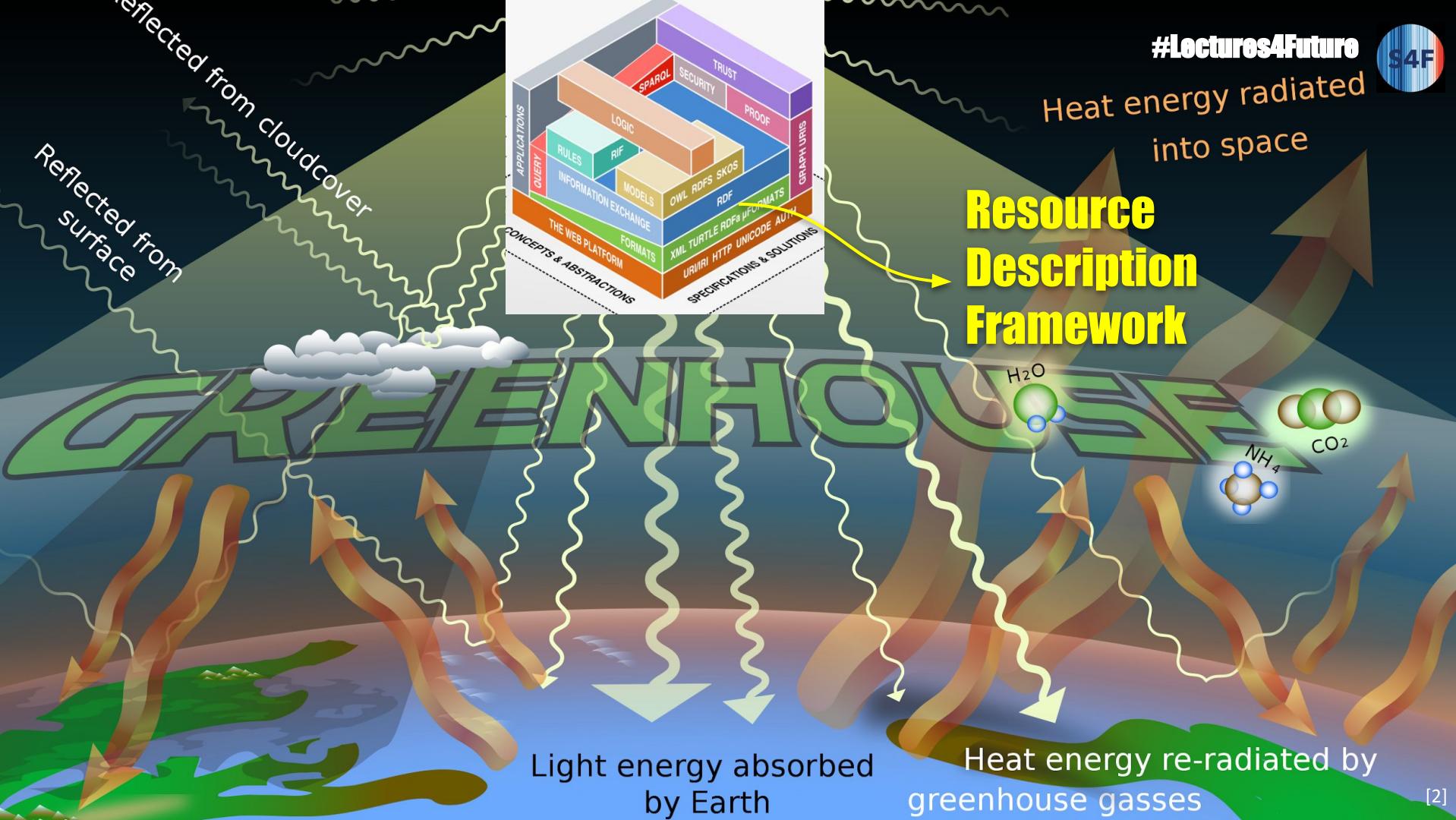
2.5 Model Building with RDFS

2.6 Logical Inference with RDF(S)

Excursion 1: RDFa - RDF and the Web

Basic Architecture of the Web of Data





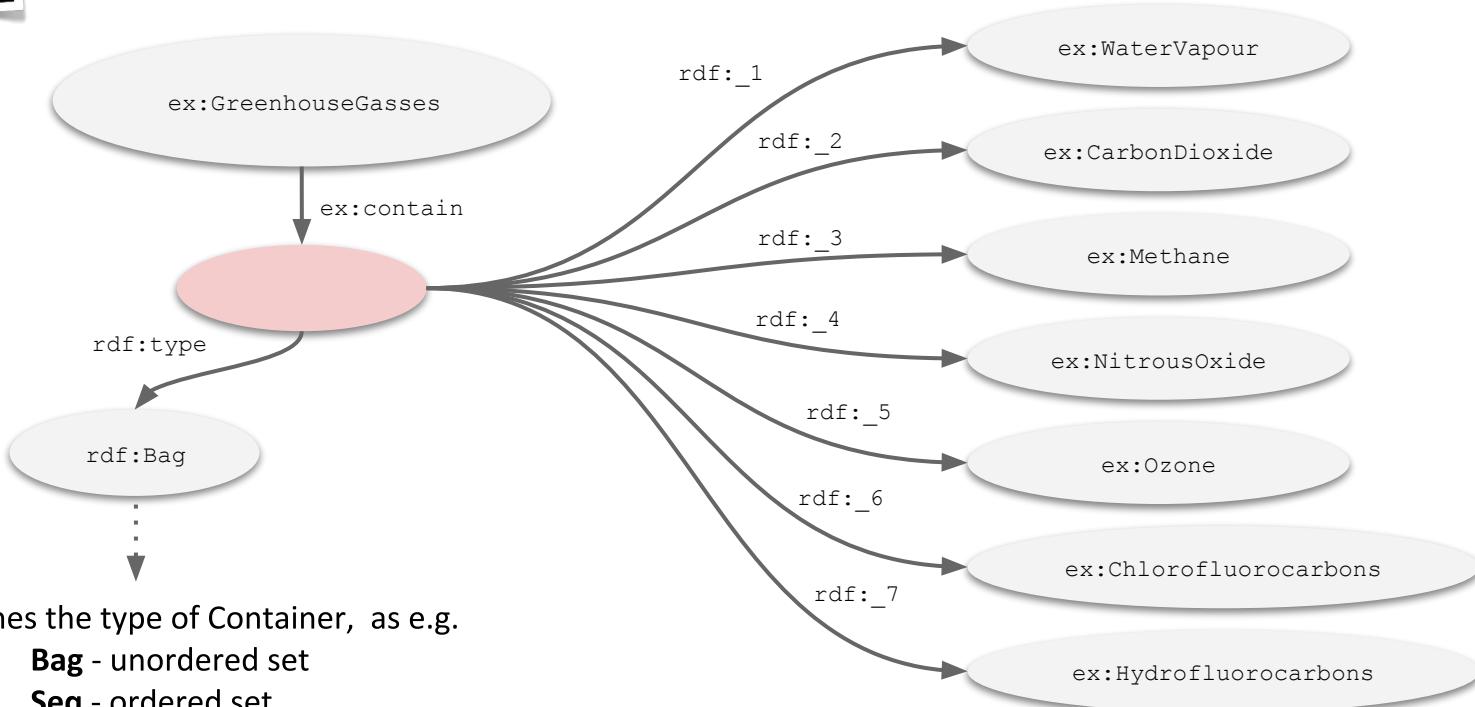


RDF Complex Data Structures

- **RDF Lists**
 - General data structures to enumerate any resources or literals
 - No new semantics, just “syntactic sugar”
- Distinguish between
 - **Container**
 - **open** list, i.e. extension (new entries) possible
 - **Collections**
 - **closed** list, i.e. no extension possible

RDF Container

Open List



defines the type of Container, as e.g.

- **Bag** - unordered set
- **Seq** - ordered set
- **Alt** - alternatives

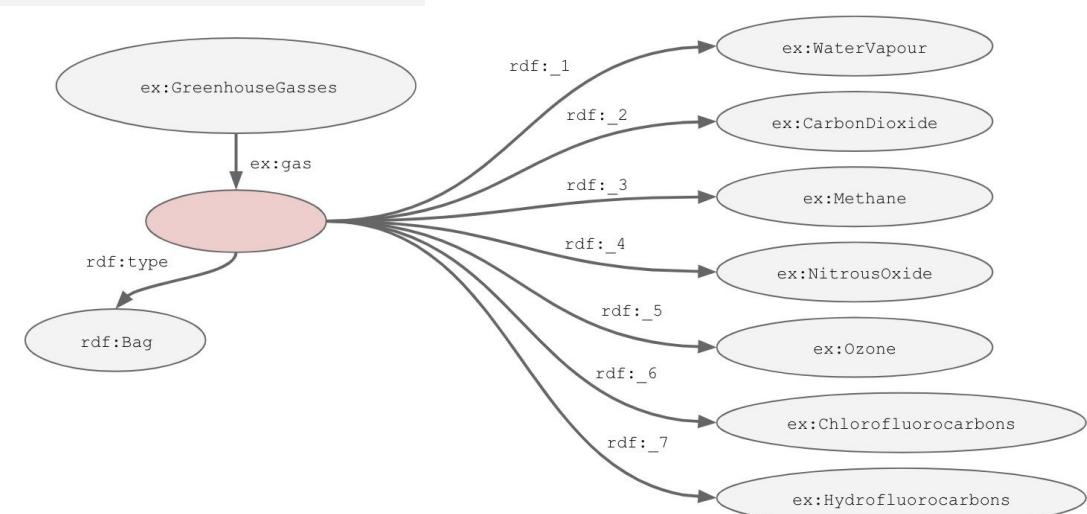
RDF Container

Open List

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix ex: <http://example.org/test#> .

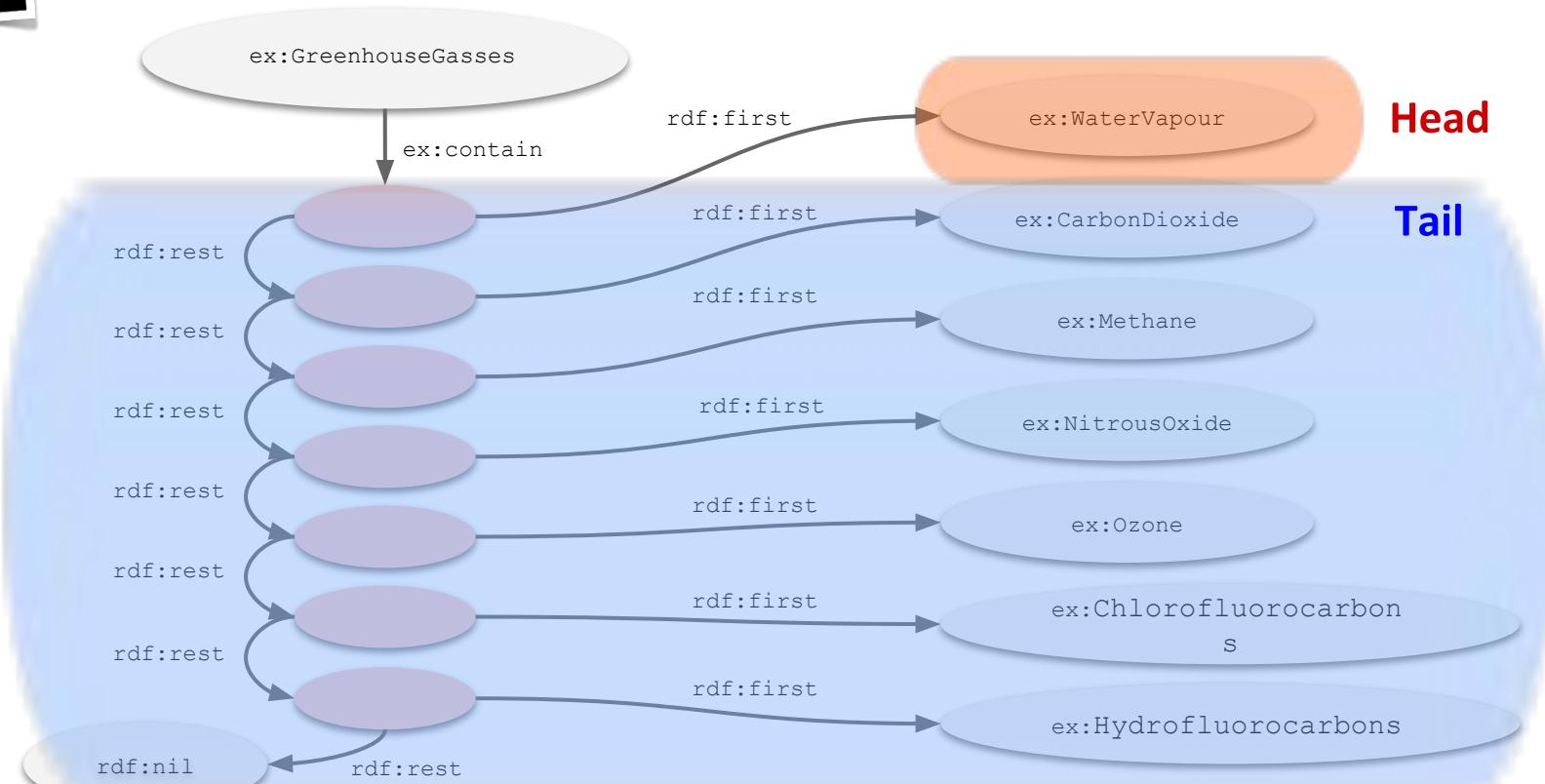
ex:GreenhouseGasses ex:contain [
    a rdf:Bag ;
    rdf:_1 ex:WaterVapour ;
    rdf:_2 ex:CarbonDioxide ;
    rdf:_3 ex:Methane ;
    rdf:_4 ex:NitrousOxide ;
    rdf:_5 ex:Ozone ;
    rdf:_6 ex:Chlorofluorocarbons ;
    rdf:_7 ex:Hydrofluorocarbons
] .
```

= **rdf:type** rdf:Bag



RDF Collection

Closed List



RDF Collection

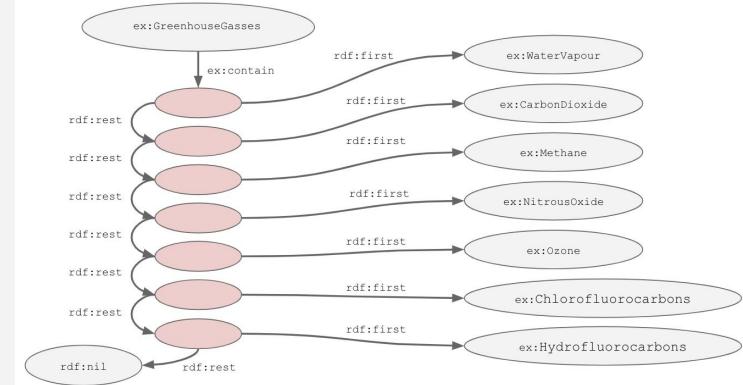
Closed List

```

@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
.

@prefix ex: <http://example.org/test#> .

ex:GreenhouseGasses ex:contain [
  rdf:first ex:WaterVapour ; rdf:rest [
    rdf:first ex:CarbonDioxide ; rdf:rest [
      rdf:first ex:Methane ; rdf:rest [
        rdf:first ex:NitrousOxide ; rdf:rest [
          rdf:first ex:Ozone ; rdf:rest [
            rdf:first ex:Chlorofluorocarbons ; rdf:rest [
              rdf:first ex:Hydrofluorocarbons
              rdf:rest rdf:nil
            ]
          ]
        ]
      ]
    ]
  ]
]
```



```

@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix ex: <http://example.org/test#> .

ex:GreenhouseGasses ex:contain (
  ex:WaterVapour ex:CarbonDioxide ex:Methane ex:NitrousOxide
  ex:Ozone ex:Chlorofluorocarbons ex:Hydrofluorocarbons
) .
```



WIKIPEDIA

The Free Encyclopedia

“Wikipedia states that Carbon Dioxide has been discovered by Jan Baptist van Helmont.”



Jan Baptist van Helmont
Dutch chemist
1580-1644



RDF Reification

- RDF also permits the interleaving of statements, i.e. to make statements about statements
- Example:
 - Wikipedia states that Carbon Dioxide was discovered by Jan Baptist van Helmont

■ Part 1: Carbon Dioxide was discovered by Jan Baptist van Helmont

dbr:Carbon_Dioxide dbo:discoveredBy dbr:Jan_Baptist_van_Helmont

.

■ Part 2: Wikipedia states

dbr:Wikipedia ex:states ????



RDF Reification

- **rdf:Statement**

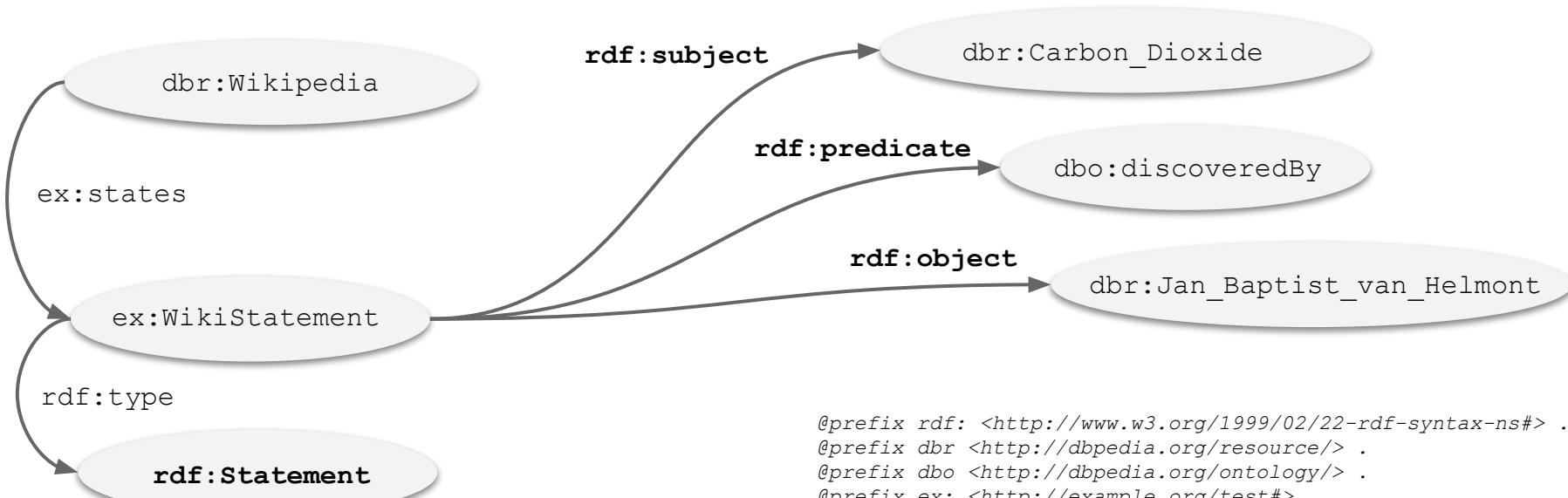
defines an RDF statement consisting of subject, predicate, object.

- **rdf:subject** - the described resource
- **rdf:predicate** - the original property
- **rdf:object** - the value of the property

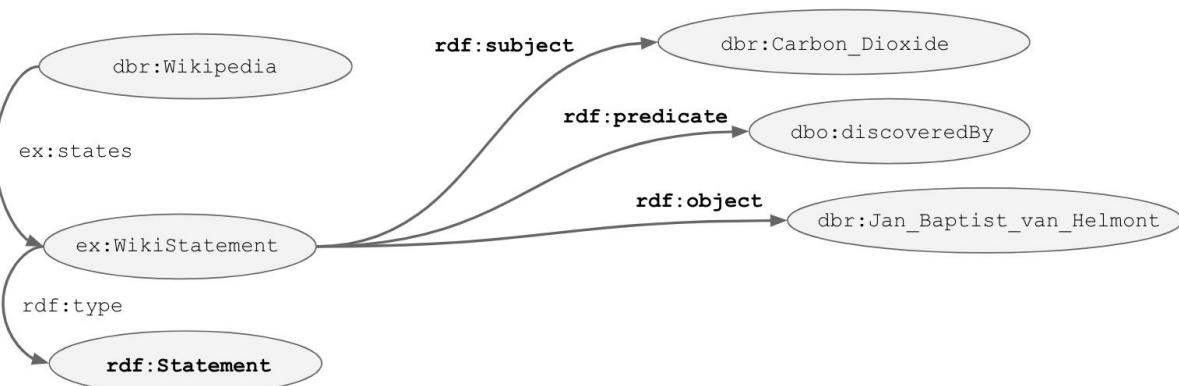


RDF Reification

Wikipedia states that carbon dioxide was discovered by Jan Baptist van Helmont.



RDF Reification



```

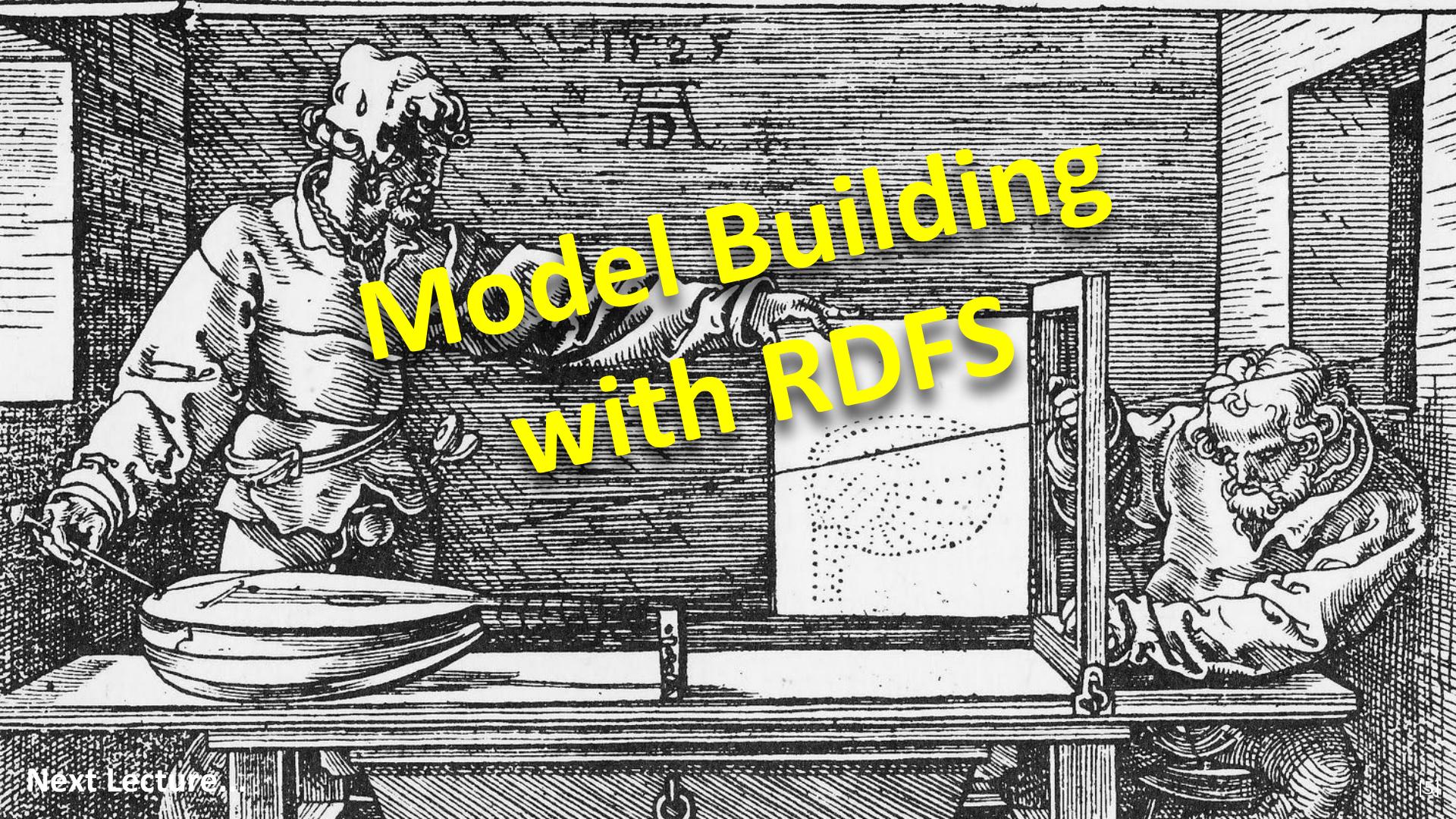
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix dbr <http://dbpedia.org/resource/> .
@prefix dbo <http://dbpedia.org/ontology/> .
@prefix ex: <http://example.org/test#> .

dbr:Wikipedia ex:states ex:WikiStatement .
ex:WikiStatement a rdf:Statement ;
  rdf:subject dbr:Carbon_Dioxide ;
  rdf:predicate dbo:discoveredBy ;
  rdf:object dbr:Jan_Baptist_van_Helmont .
  
```



RDF Reification

- What is the use of reification?
 - Modeling **data provenance**
 - Formalizing statements about **reliability** and **trust**
 - Define **metadata** about statements
- **But you should be careful....**
 - **Relations** and **classes** can be transformed into **instances** potentially resulting in **type conflicts**
 - Risk to define **infinite recursions** and **cycles**



Model Building with RDFS

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 Green House Effect, A loose necktie [CC BY-SA]
<https://commons.wikimedia.org/wiki/File:Greenhouse-effect-t445.svg>
- [3] Wikipedia Logo, Wikimedia Foundation [CC BY-SA]
<https://commons.wikimedia.org/wiki/File:Wikipedia-logo-v2-en.svg>
- [4] Jan Baptist van Helmont , painted c1674 by Mary Beale, [Public Domain]
https://commons.wikimedia.org/wiki/File:Jan_Baptist_van_Helmont_portrait.jpg
- [5] Stich aus Dürers Anweisung zur Messung mit Zirkel und Richtscheid, Albrecht Dürer, 1525, [Public Domain]
https://commons.wikimedia.org/wiki/File:D%C3%BCrer_Stich_aus_Anweisung.jpg