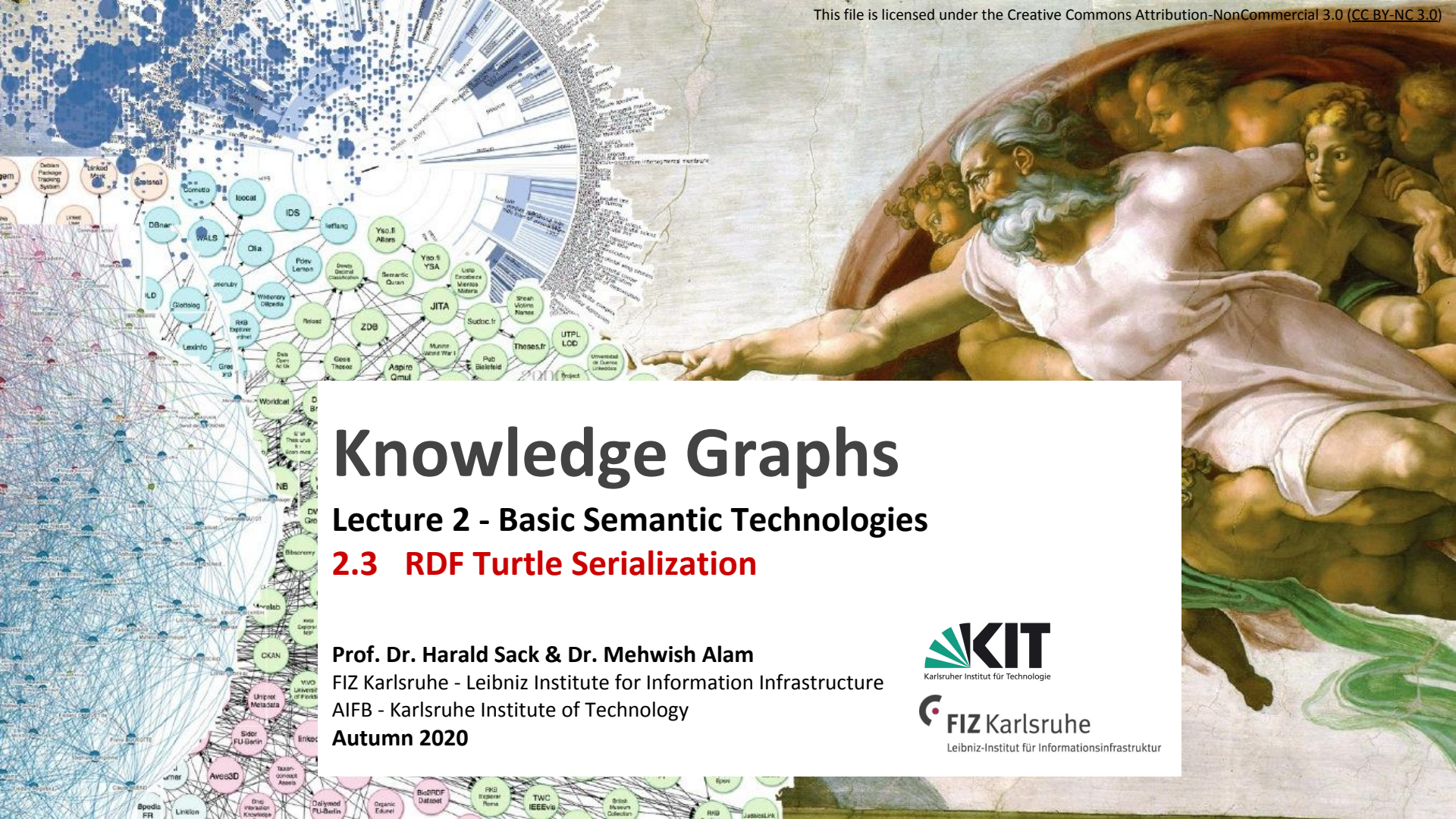


Knowledge Graphs

Lecture 2 - Basic Semantic Technologies

2.3 RDF Turtle Serialization

Prof. Dr. Harald Sack & Dr. Mehwish Alam
FIZ Karlsruhe - Leibniz Institute for Information Infrastructure
AIFB - Karlsruhe Institute of Technology
Autumn 2020

Karlsruher Institut für Technologie

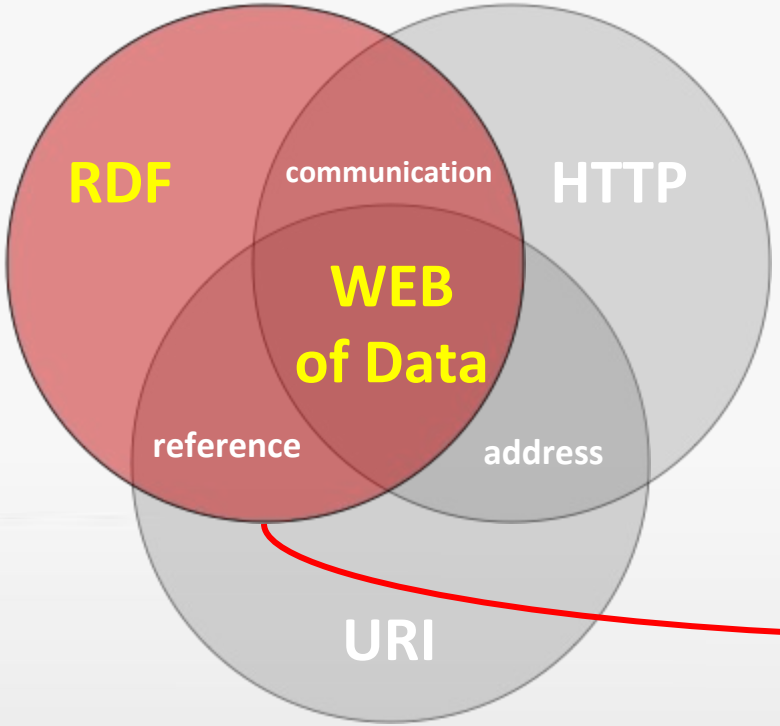
FIZ Karlsruhe
Leibniz-Institut für Informationsinfrastruktur

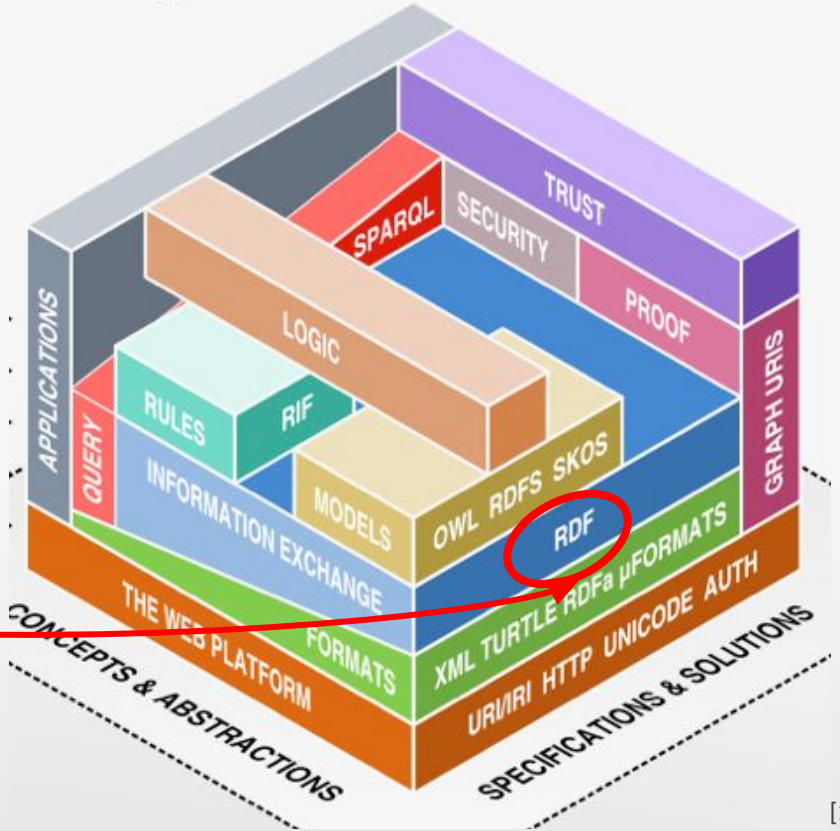
Knowledge Graphs

Lecture 2: Basic Semantic Technologies

Basic Architecture of the Web of Data

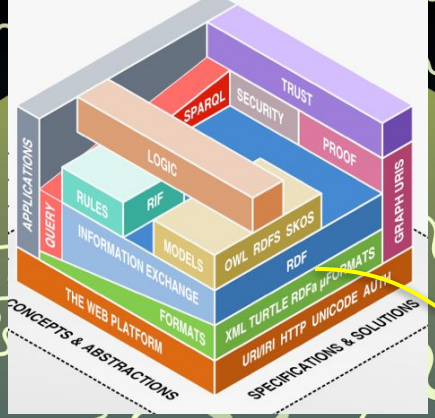
Karlsruher Institut für Technologie
FIZ Karlsruhe
Leibniz Institute for Information Infrastructure





[1]

#Lectures4Future



Resource Description Framework

Heat energy radiated into space

Reflected from cloudcover

Reflected from surface

GREENHOUSE

H_2O

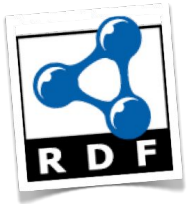
CO_2

NH_4

Light energy absorbed by Earth

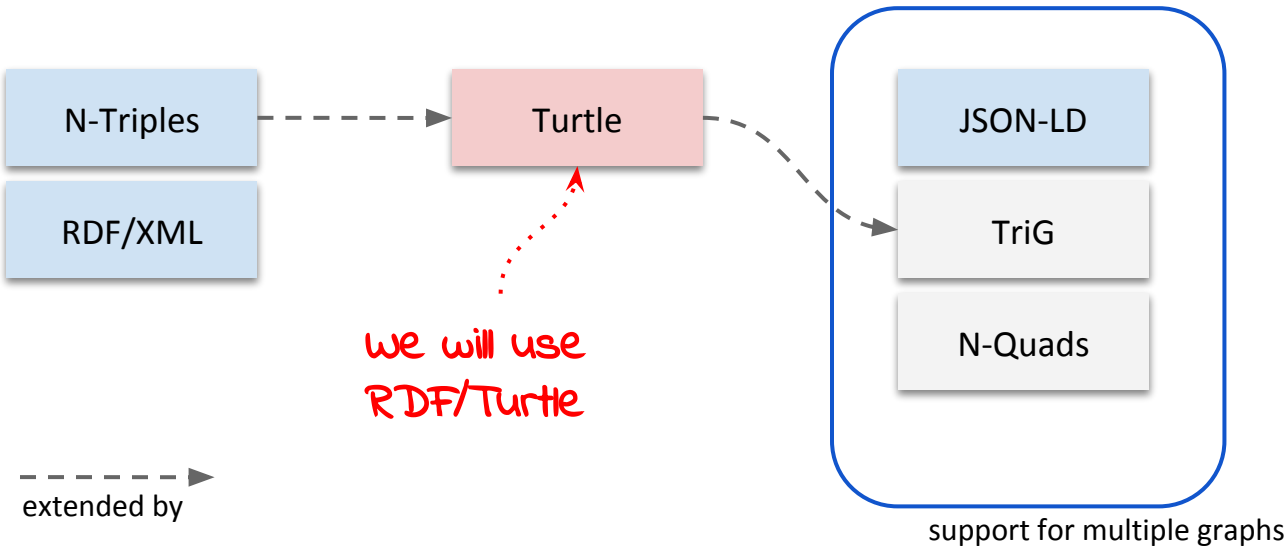
Heat energy re-radiated by greenhouse gasses

[2]

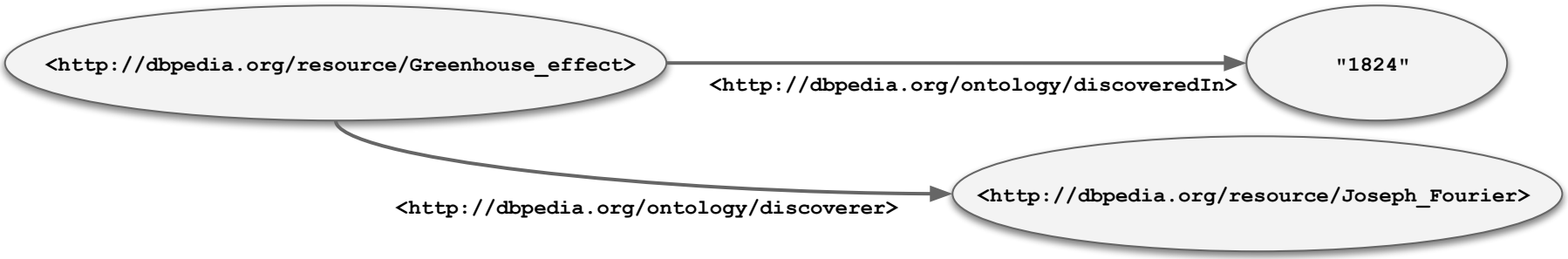


RDF Serializations

- RDF comes with several different **serialization formats**:
  - N-Triples, RDF/XML, JSON, Turtle, TriG, N-Quads, RDFa, ...



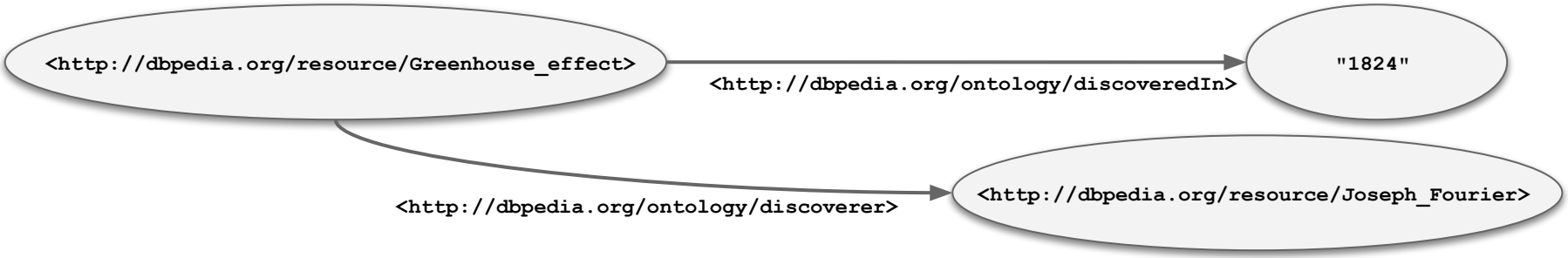
RDF Serializations



- **N-Triples Notation**
  - **URIs/IRIs** in angle brackets
  - **Literals** in quotation marks
  - Triple ends with a **period**

```
<http://dbpedia.org/resource/Greenhouse_effect> <http://dbpedia.org/ontology/discoveredIn> "1824" .

<http://dbpedia.org/resource/Greenhouse_effect> <http://dbpedia.org/ontology/discoverer>
<http://dbpedia.org/resource/Joseph_Fourier> .
```

RDF Serializations

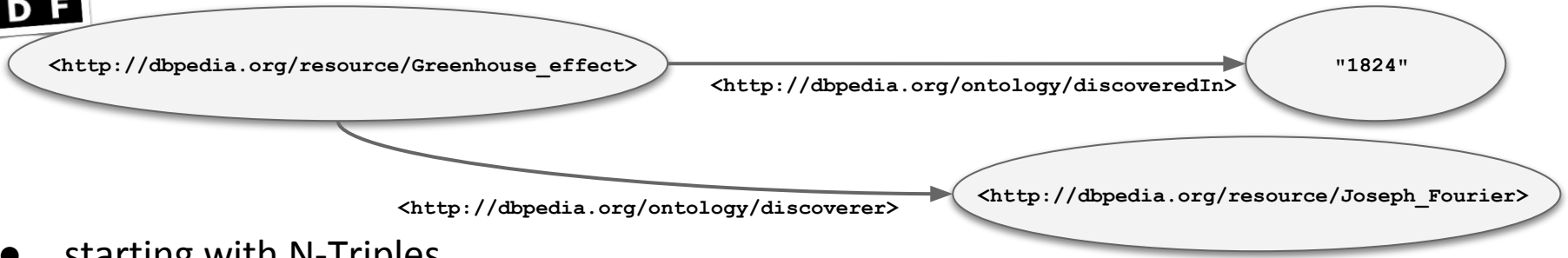


- **Turtle (Terse RDF Triple Language) Notation**
  - extension of N-Triples

```
@prefix dbo: <http://dbpedia.org/ontology/> .
@base  <http://dbpedia.org/resource/> .

<Greenhouse_effect> dbo:discoveredIn "1824" .

<Greenhouse_effect> dbo:discoverer <Joseph_Fourier> .
```

RDF/Turtle allows shortcuts and abbreviations for readability

RDF/Turtle



- starting with N-Triples

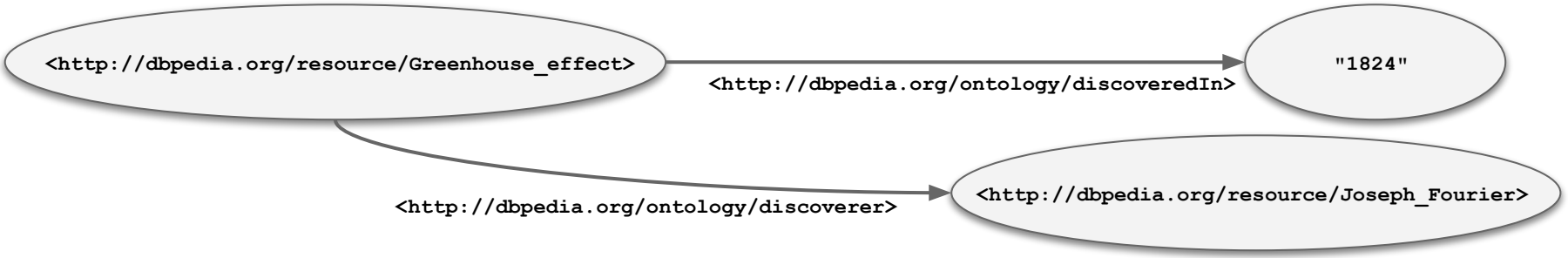
```
<http://dbpedia.org/resource/Greenhouse_effect> <http://dbpedia.org/ontology/discoveredIn> "1824" .

<http://dbpedia.org/resource/Greenhouse_effect> <http://dbpedia.org/ontology/discoverer>
<http://dbpedia.org/resource/Joseph_Fourier> .
```

```
@prefix dbo: <http://dbpedia.org/ontology/> .
@base  <http://dbpedia.org/resource/> .

<Greenhouse_effect> dbo:discoveredIn "1824" .

<Greenhouse_effect> dbo:discoverer <Joseph_Fourier> .
```

@prefix directive associates prefix-label with URI

@base directive provides URI to complement all relative URIs

RDF/Turtle

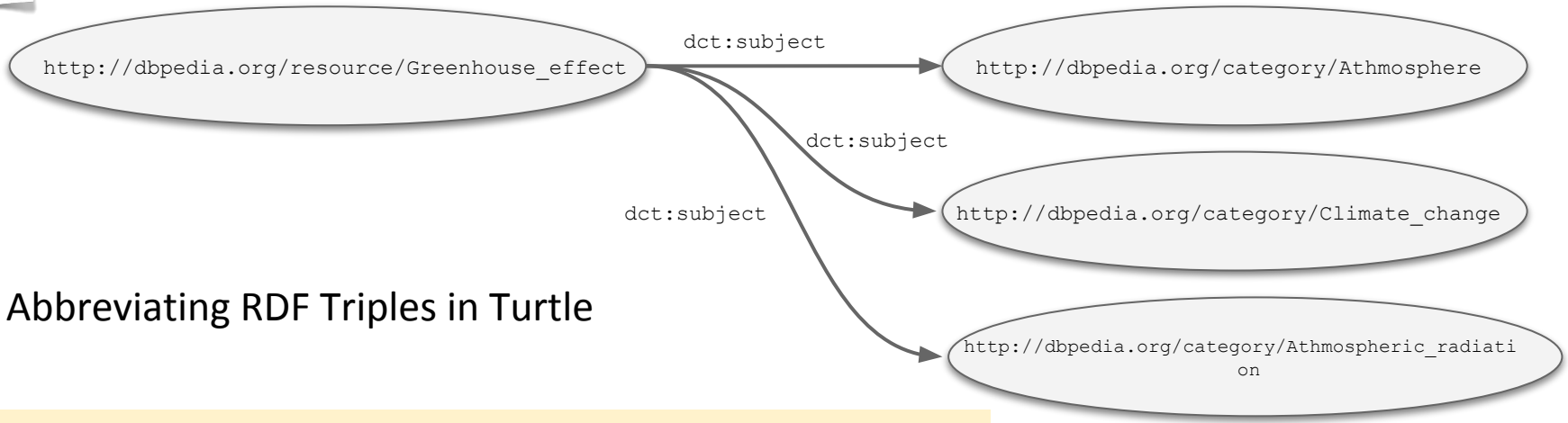


- Abbreviating RDF Triples in Turtle

```
@prefix dbo: <http://dbpedia.org/ontology/> .
@base  <http://dbpedia.org/resource/> .

<Greenhouse_effect> dbo:discoveredIn "1824" ;
                    dbo:discoverer <Joseph_Fourier> .
```

semicolon indicates that subsequent triples have the same subject **(predicate list)**

RDF/Turtle

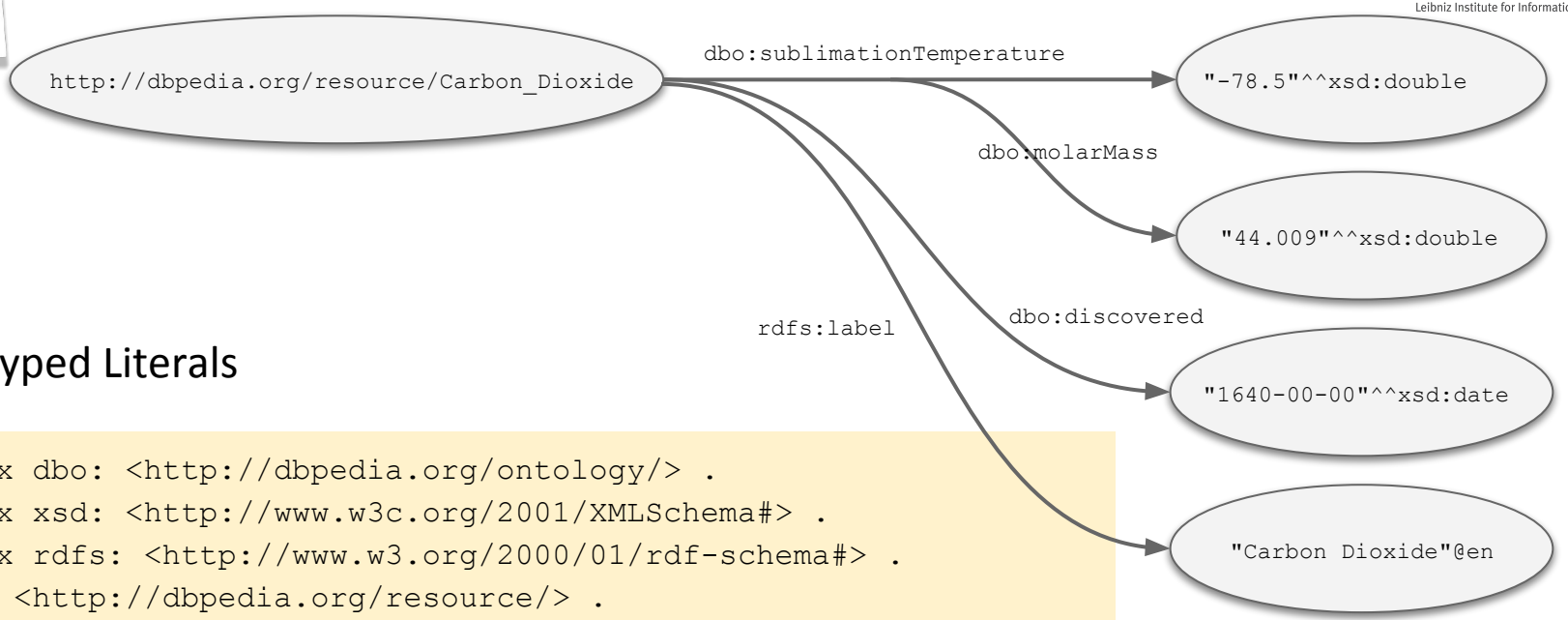


- Abbreviating RDF Triples in Turtle

```
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dbc: <http://dbpedia.org/category/> .
@base        <http://dbpedia.org/resource/> .

<Greenhouse_effect> dct:subject dbc:Athmosphere ,
                                dbc:Climate_change ,
                                dbc:Athmospheric_radiation .
```

comma indicates that subsequent triples have same subject and property **(object list)**

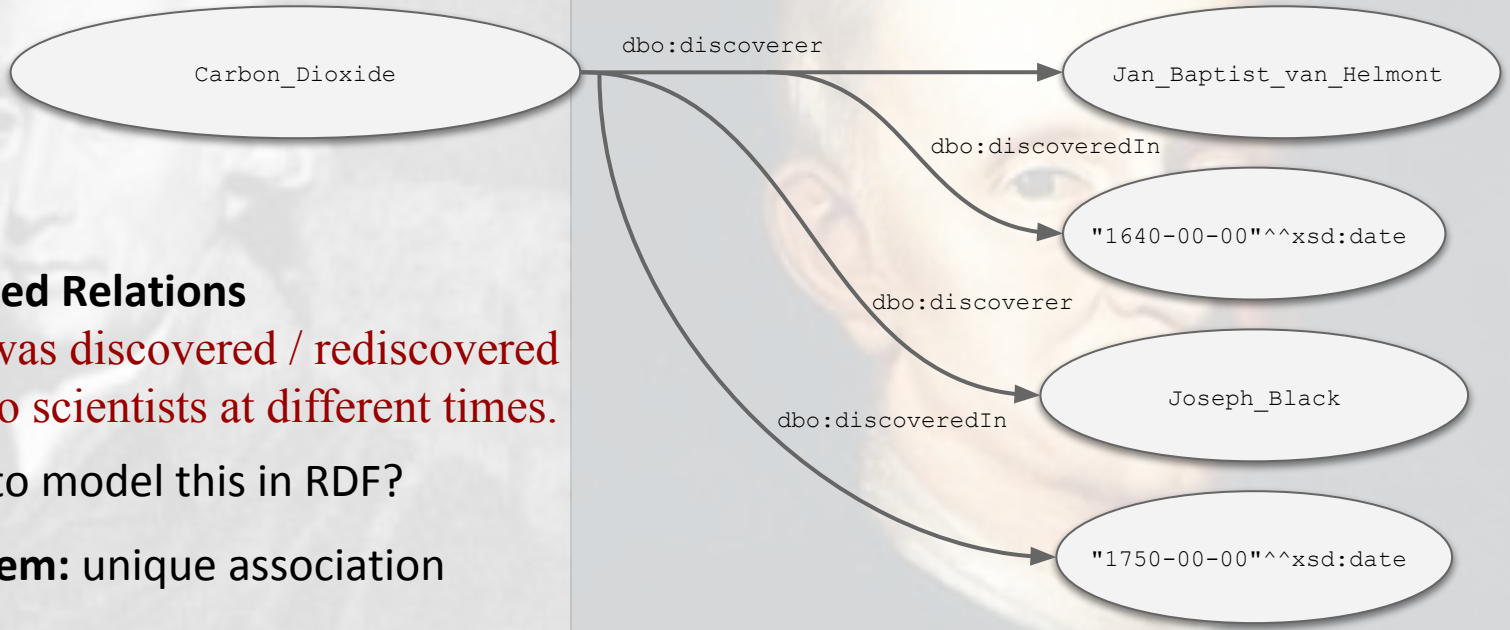
RDF/Turtle



- Typed Literals

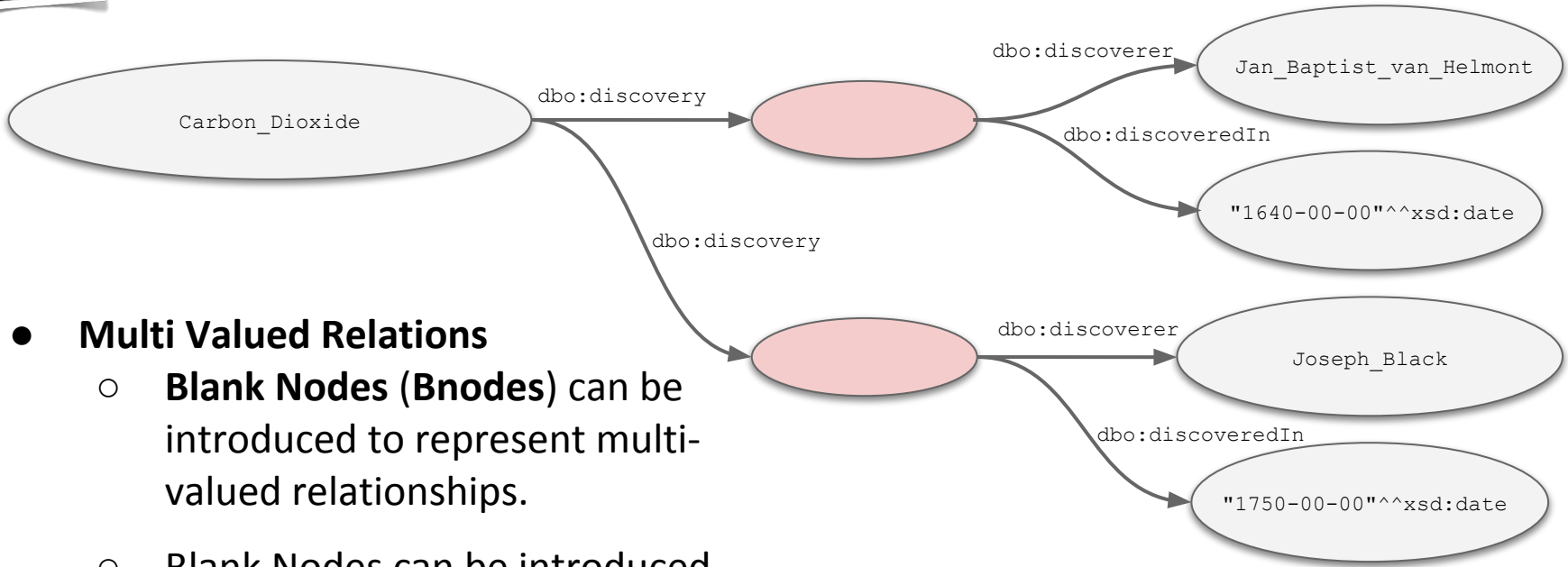
```
@prefix dbo: <http://dbpedia.org/ontology/> .
@prefix xsd: <http://www.w3c.org/2001/XMLSchema#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@base  <http://dbpedia.org/resource/> .

<Carbon_Dioxide> dbo:sublimationTemperature "-78.5"^^xsd:double ;
                 dbo:molarMass "44.009"^^xsd:double ;
                 dbo:discovered "1640-00-00"^^xsd:date ;
                 rdfs:label "Carbon Dioxide"@en .
```

RDF/Turtle



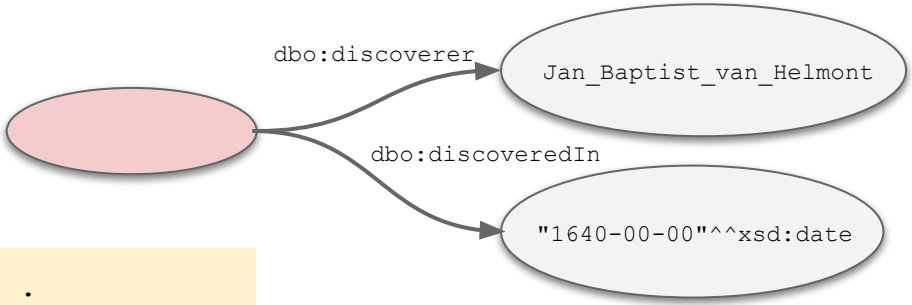
- **Multi Valued Relations**
  - CO_2 was discovered / rediscovered by two scientists at different times.
  - How to model this in RDF?
  - **Problem:** unique association

RDF/Turtle



- **Multi Valued Relations**
  - **Blank Nodes** (**Bnodes**) can be introduced to represent multi-valued relationships.
  - Blank Nodes can be introduced for resources that don‘t need a name (auxiliary nodes).

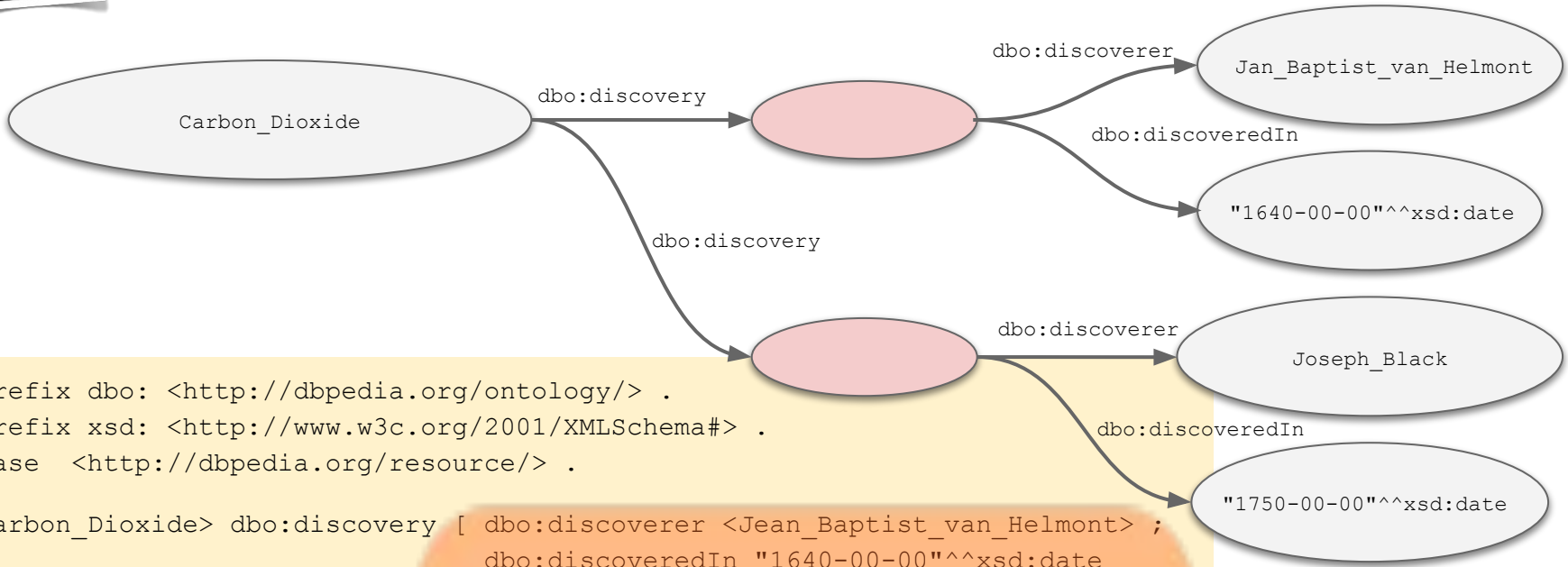
RDF/Turtle




```
@prefix dbo: <http://dbpedia.org/ontology/> .
@prefix xsd: <http://www.w3c.org/2001/XMLSchema#> .
@base  <http://dbpedia.org/resource/> .

[] dbo:discoverer <Jan_Baptist_van_Helmont> ;
   dbo:discoveredIn "1640-00-00"^^xsd:date .
```

anonymous blank node as subject

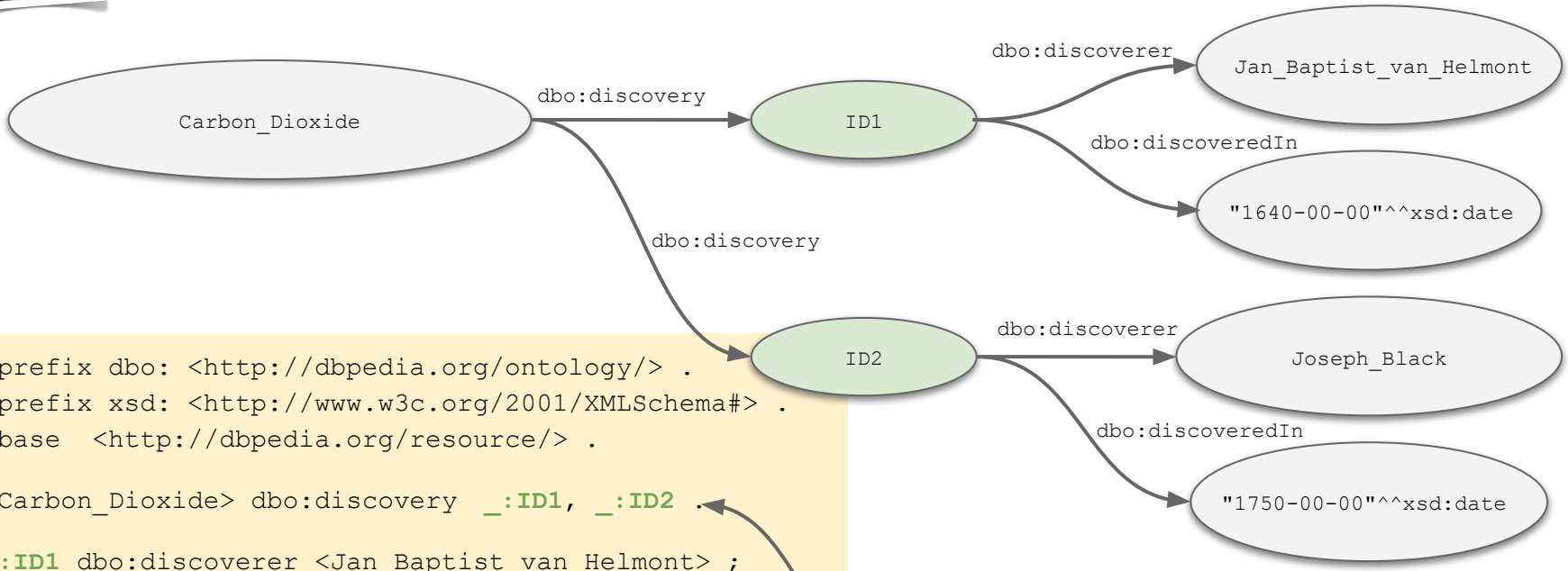
RDF/Turtle




```
@prefix dbo: <http://dbpedia.org/ontology/> .
@prefix xsd: <http://www.w3c.org/2001/XMLSchema#> .
@base  <http://dbpedia.org/resource/> .

<Carbon_Dioxide> dbo:discovery [ dbo:discoverer <Jean_Baptist_van_Helmont> ;
                                 dbo:discoveredIn "1640-00-00"^^xsd:date
                               ] ,
                               [ dbo:discoverer <Joseph_Black> ;
                                 dbo:discoveredIn "1750-00-00"^^xsd:date
                               ] .
```

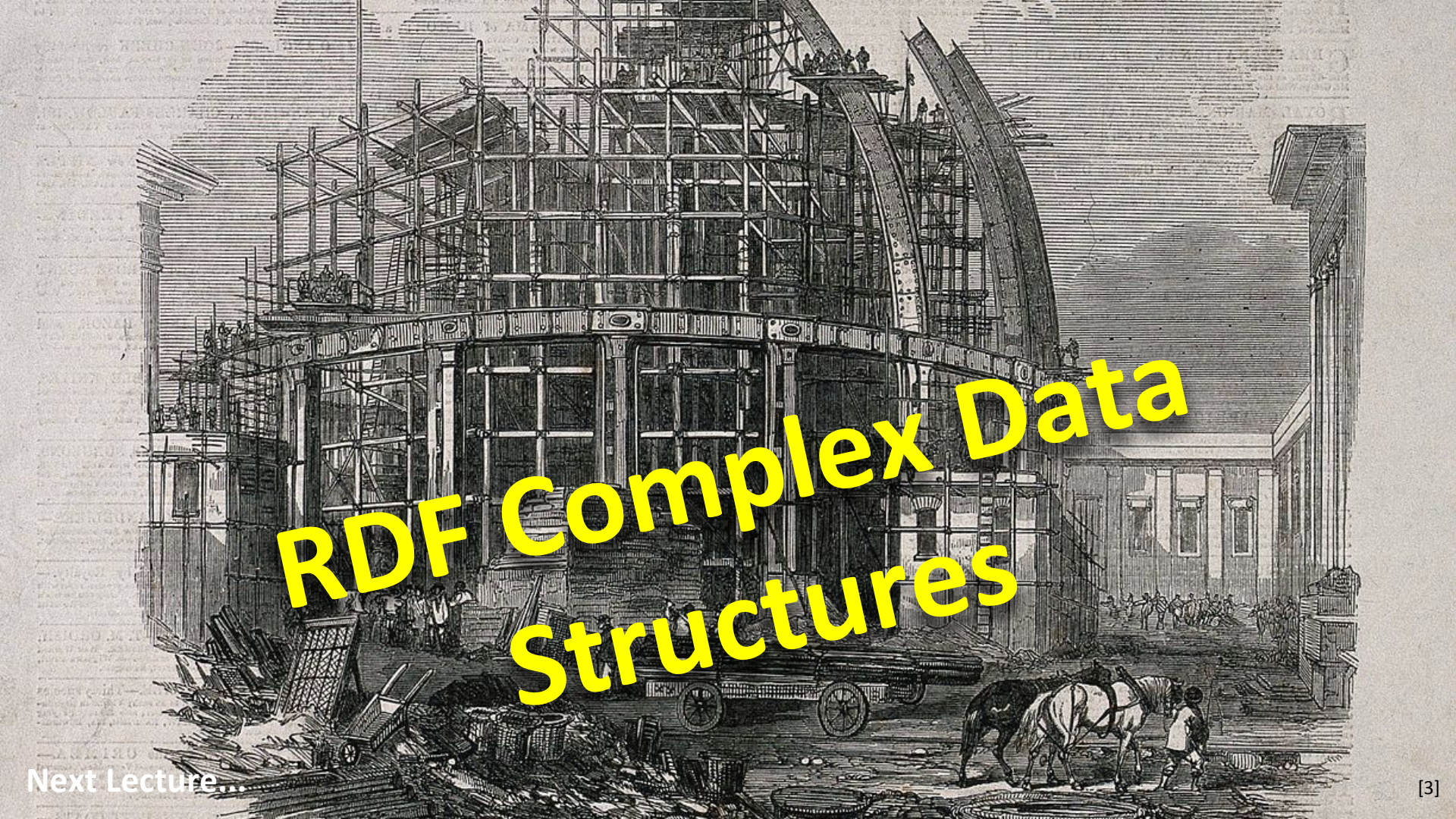
nested anonymous blank nodes

RDF/Turtle




```
@prefix dbo: <http://dbpedia.org/ontology/> .
@prefix xsd: <http://www.w3c.org/2001/XMLSchema#> .
@base  <http://dbpedia.org/resource/> .

<Carbon_Dioxide> dbo:discovery  _:ID1, _:ID2 .

_:ID1 dbo:discoverer <Jan_Baptist_van_Helmont> ;
      dbo:discoveredIn "1640-00-00"^^xsd:date .

_:ID2 dbo:discoverer <John_Black> ;
      dbo:discoveredIn "1750-00-00"^^xsd:date .
```

dereferenceable blank nodes can only be referenced from inside a document / graph



Next Lecture...

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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] The British Museum: the reading room under construction. Wood engraving by J. Brown after C. W. Sheeres, 1855., The Wellcome Collection, [CC-BY-4.0]
  https://upload.wikimedia.org/wikipedia/commons/a/ad/The_British_Museum%3B_the_reading_room_under_construction._Woo_Wellcome_V0013519.jpg