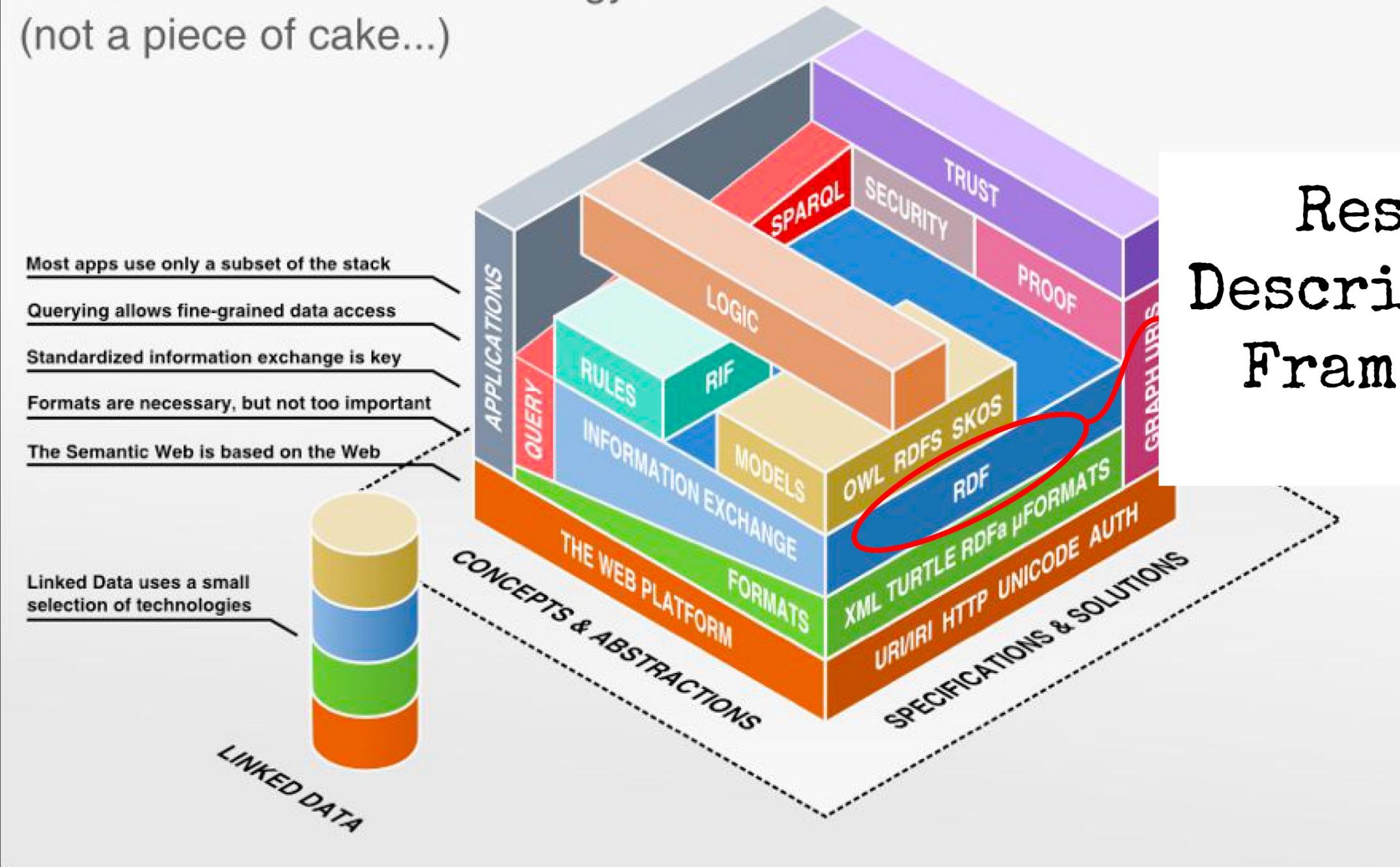
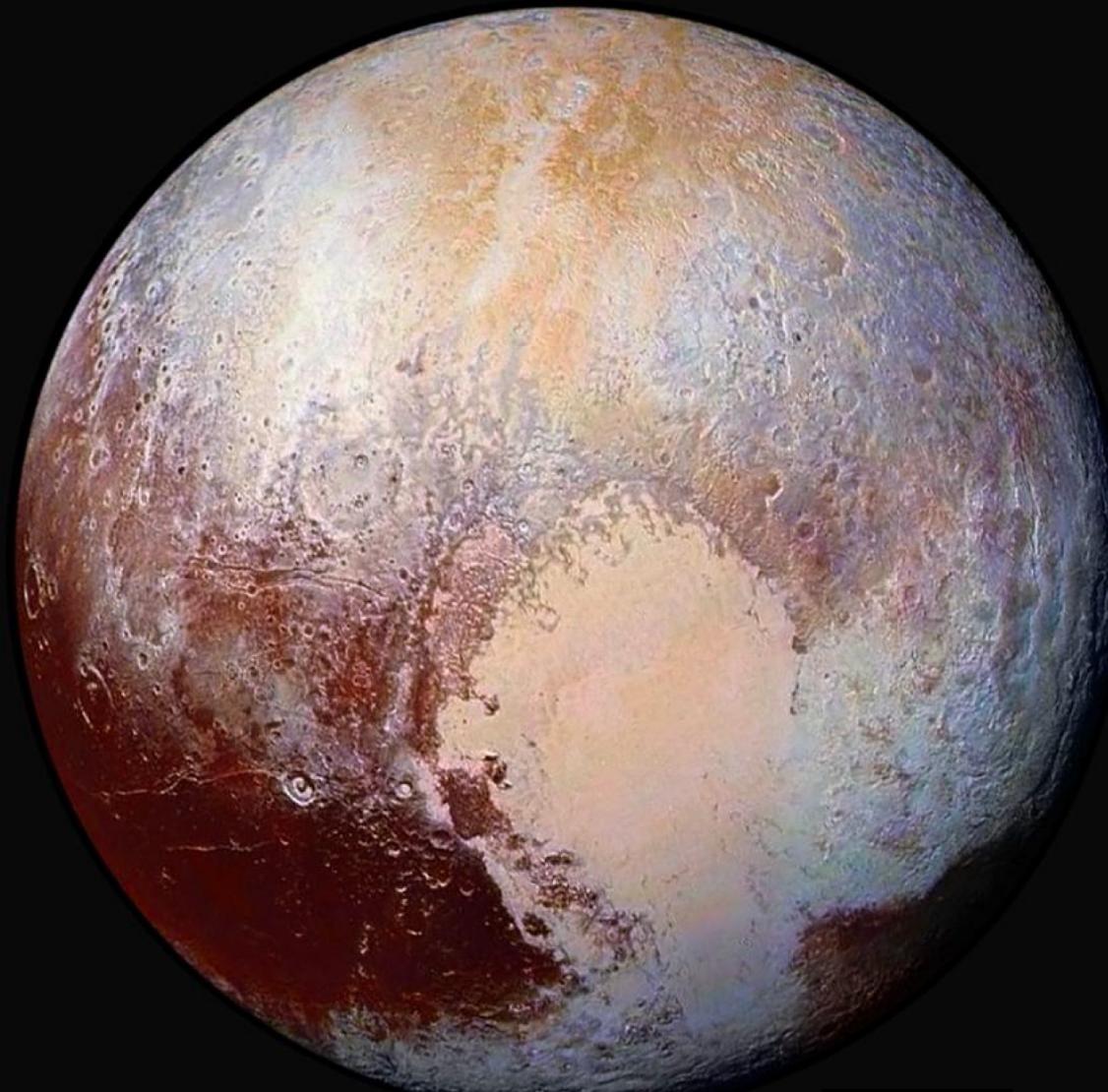


The Semantic Web Technology Stack (not a piece of cake...)



Resource Description Framework (RDF)

Simple Facts with RDF



PLUTO
Never Forget!
(1930–2006)



Resource Description Framework

- **Resource**
 - can be everything
 - must be uniquely **identified** and **referenceable** via **URI**
- **Description**
 - = description of resources
 - via representing properties and relationships among resources as **graphs**
- **Framework**
 - = combination of web based protocols (URI, HTTP, XML, Turtle, JSON, ...)
 - based on formal model (semantics)
- Knowledge in RDF is expressed as a **list of statements**
- all RDF statements follow the same simple schema (= **RDF Triple**)



Resource Description Framework

- **RDF Statements (RDF Triple):**

Subject + Property + Object / Value

URI

URI

Object / Value

URI / Literal

RDF Building Blocks

N-Triples Serialization

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

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

"1930" .

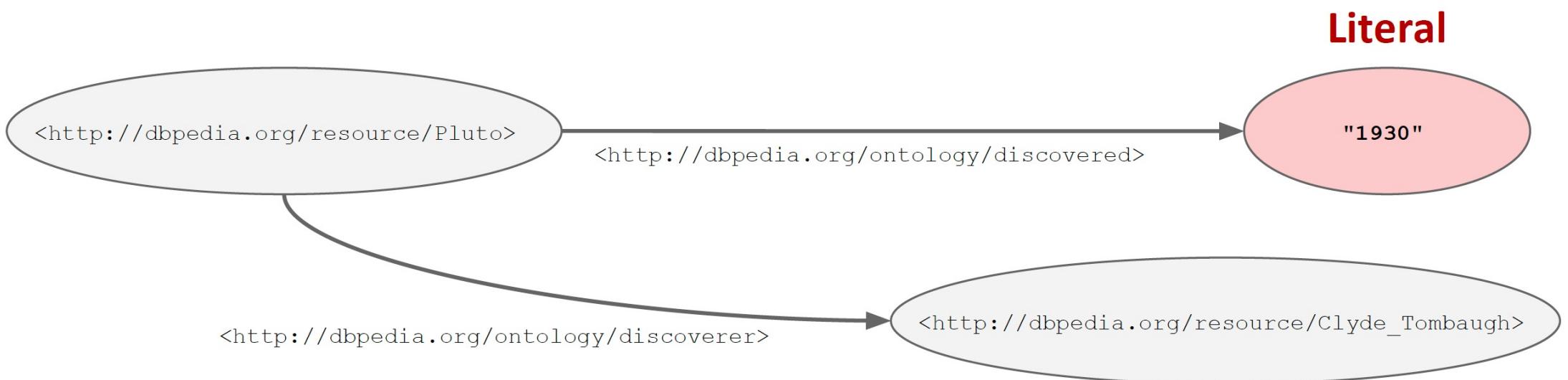


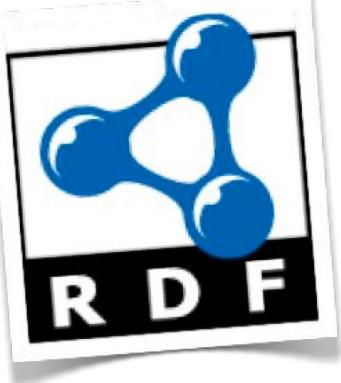
**graph
representation**



Resource Description Framework

- **URIs and Literals**
 - **URIs** reference resources uniquely
 - **Literals** describe data values that don't have a separate existence



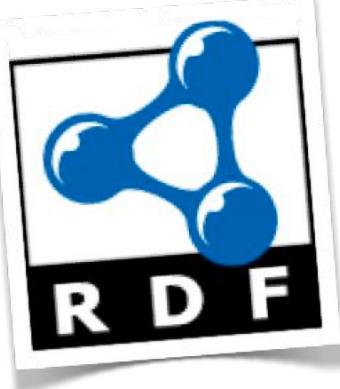


Literals and Datatypes

- Typed literals can be expressed via **XML Schema datatypes**
- Namespace for typed literals:
`http://www.w3.org/2001/XMLSchema#`
- Examples:
`"Semantics"^^<http://www.w3.org/2001/XMLSchema#string>`
`"1161.00"^^<http://www.w3.org/2001/XMLSchema#float>`
`"2015-08-02"^^<http://www.w3.org/2001/XMLSchema#date>`
- **Language Tags** denote the (natural) language of the text:
 - Example:
`"Semantik"@de , "Semantics"@en`

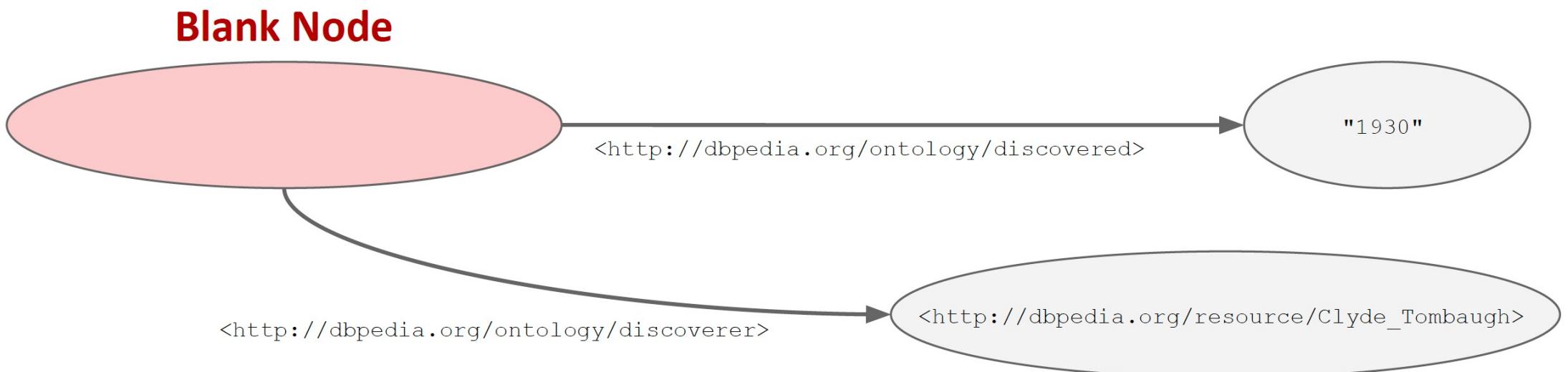
<http://www.w3.org/TR/2013/WD-rdf11-concepts-20130115/#xsd-datatypes>

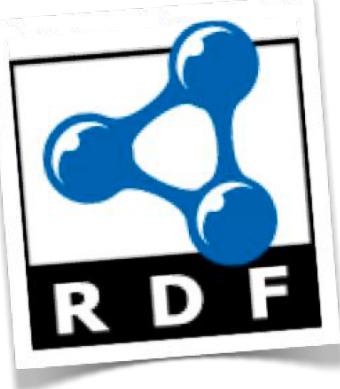
Core types	<code>xsd:string</code>	Character strings
	<code>xsd:boolean</code>	true, false
	<code>xsd:decimal</code>	Arbitrary-precision decimal
	<code>xsd:integer</code>	Arbitrary-size integer number
IEEE floating-point numbers	<code>xsd:double</code>	64-bit floating point numbers
	<code>xsd:float</code>	32-bit floating point numbers
	<code>xsd:date</code>	Dates (yyyy-mm-dd) with or without time zone
	<code>xsd:time</code>	Times (hh:mm:ss.sss...) with or without date
Time and date	<code>xsd:dateTime</code>	Date and time with or without time zone
	<code>xsd:dateTimeStamp</code>	Date and time with required time zone
	<code>xsd:gYear</code>	Gregorian calendar year
	<code>xsd:gMonth</code>	Gregorian calendar month
Recurring and partial dates	<code>xsd:gDay</code>	Gregorian calendar day of the month
	<code>xsd:gYearMonth</code>	Gregorian calendar year and month
	<code>xsd:gMonthDay</code>	Gregorian calendar month and day
	<code>xsd:duration</code>	Duration of time
Limited-range integer numbers	<code>xsd:yearMonthDuration</code>	Duration of time (months and days)
	<code>xsd:dayTimeDuration</code>	Duration of time (days, hours, minutes, seconds)
	<code>xsd:byte</code>	-128...+127 (8 bit)
	<code>xsd:short</code>	-32768...+32767 (16 bit)
Encoded binary data	<code>xsd:int</code>	-2147483648...+2147483647 (32 bit)
	<code>xsd:long</code>	-9223372036854775808...+9223372036854775807 (64 bit)
	<code>xsd:unsignedByte</code>	0...255 (8 bit)
	<code>xsd:unsignedShort</code>	0...65535 (16 bit)
Miscellaneous XSD types	<code>xsd:unsignedInt</code>	0...4294967295 (32 bit)
	<code>xsd:unsignedLong</code>	0...1844674407370955161 (64 bit)
	<code>xsd:positiveInteger</code>	Integer numbers >0
	<code>xsd:nonNegativeInteger</code>	Integer numbers ≥0
Miscellaneous XSD types	<code>xsd:negativeInteger</code>	Integer numbers <0
	<code>xsd:nonPositiveInteger</code>	Integer numbers ≤0
	<code>xsd:hexBinary</code>	Hex-encoded binary data
	<code>xsd:base64Binary</code>	Base64-encoded binary data
Miscellaneous XSD types	<code>xsd:anyURI</code>	Absolute or relative URIs and URIs with fragments
	<code>xsd:language</code>	Language tags per [BCP47]
	<code>xsd:normalizedString</code>	Whitespace-normalized strings
	<code>xsd:token</code>	Tokenized strings
Miscellaneous XSD types	<code>xsd:NMTOKEN</code>	XML NMTOKENs
	<code>xsd:Name</code>	XML Names



Blank Nodes

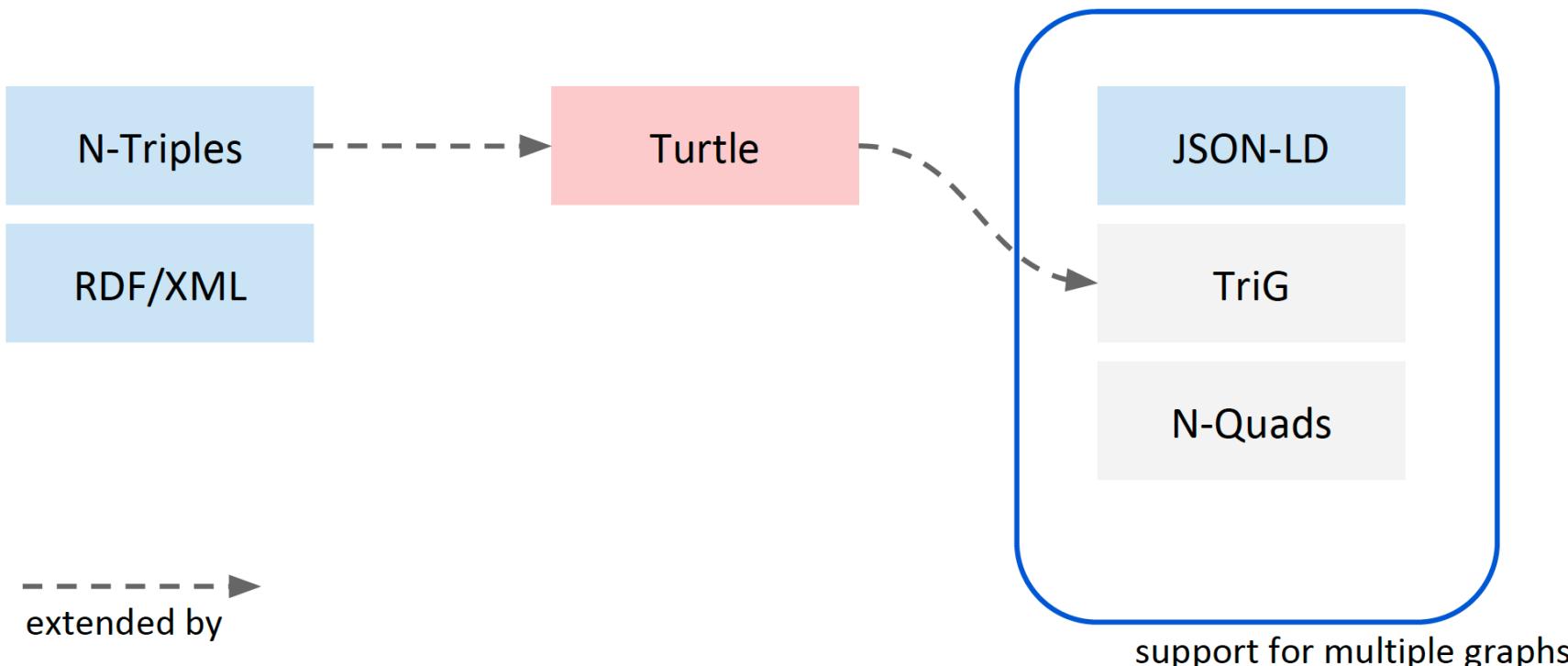
- **Blank Nodes**
 - denote **existence of an individual** with specific attributes, but **without providing an identification or reference**





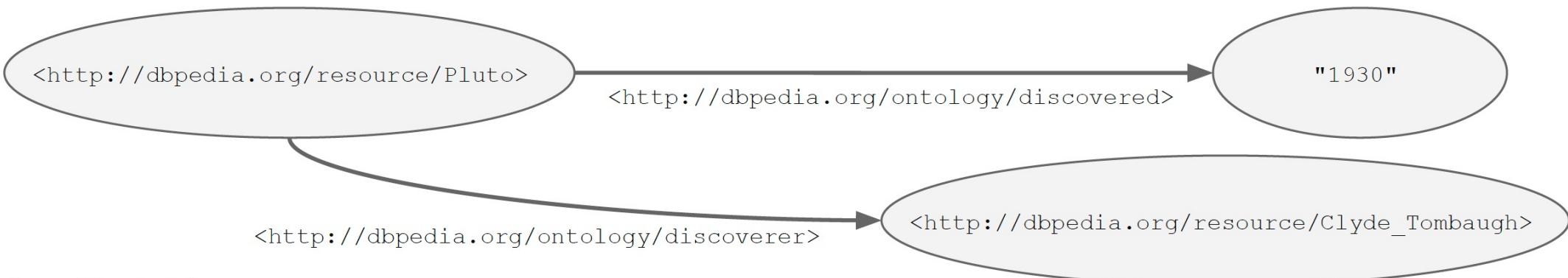
RDF Serializations

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





RDF Serializations



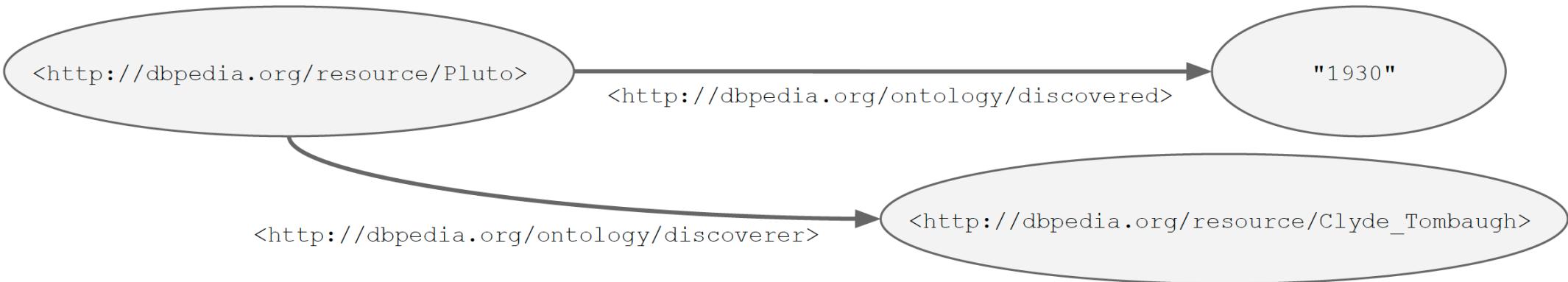
- **N-Triples Notation**

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

```
<http://dbpedia.org/resource/Pluto> <http://dbpedia.org/ontology/discovered> "1930" .  
<http://dbpedia.org/resource/Pluto> <http://dbpedia.org/ontology/discoverer>  
<http://dbpedia.org/resource/Clyde_Tombaugh> .
```



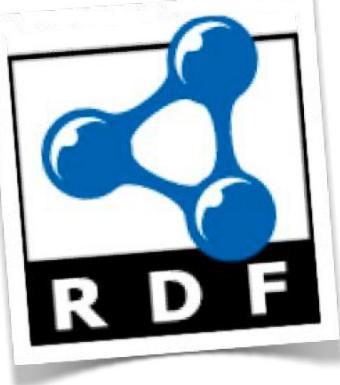
RDF Serializations



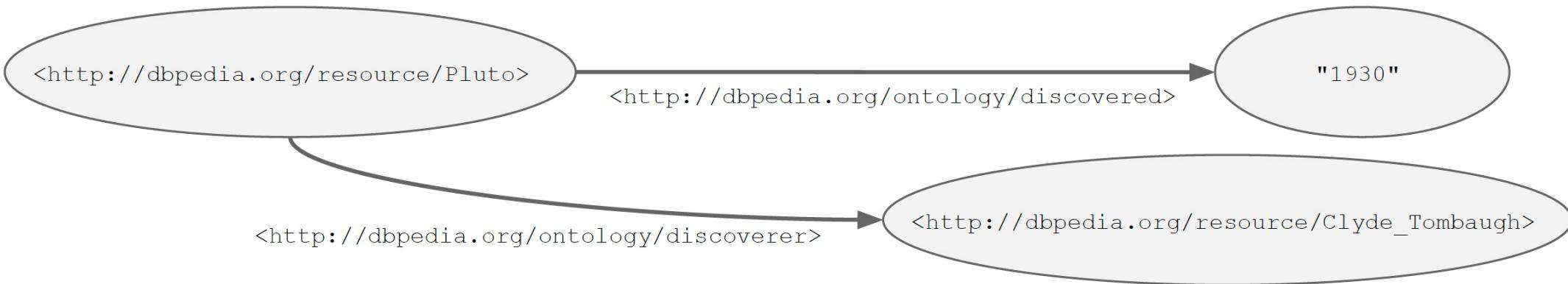
- **RDF/XML Notation**

S P O

```
<?xml version="1.0" encoding="utf-8" ?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
           xmlns:ns0="http://dbpedia.org/ontology/">
  <rdf:Description rdf:about="http://dbpedia.org/resource/Pluto">
    <ns0:discovered>1930</ns0:discovered>
    <ns0:discoverer rdf:resource="http://dbpedia.org/resource/Clyde_Tombaugh"/>
  </rdf:Description>
</rdf:RDF>
```



RDF Serializations



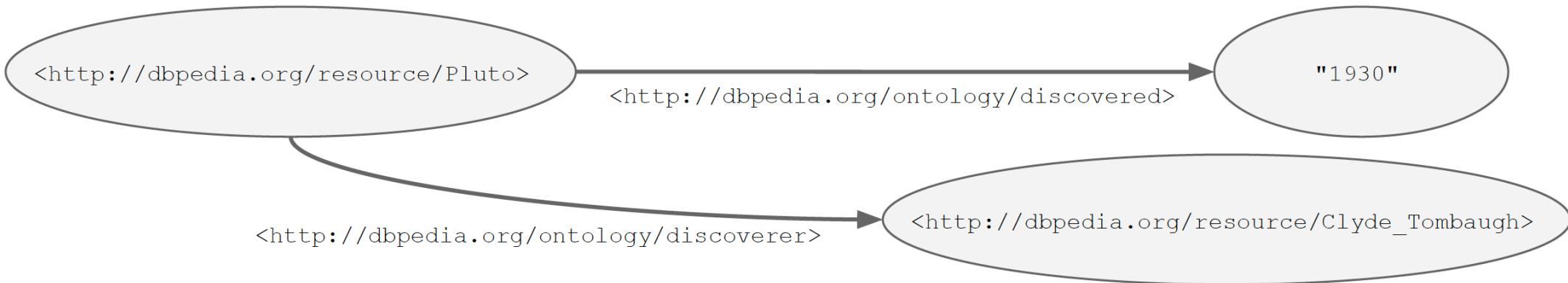
- **JSON-LD Notation (RDF 1.1)**

S P O

```
{ "@id" : "http://dbpedia.org/resource/Pluto" ,  
  "http://dbpedia.org/ontology/discovered" :  
    { "@value" : "1930" }  
,  
  "http://dbpedia.org/ontology/discoverer" :  
    { "@id" : "http://dbpedia.org/resource/Clyde_Tombaugh" }  
}
```



RDF Serializations



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

```
@prefix dbo: <http://dbpedia.org/ontology/> .  
@base  <http://dbpedia.org/resource/> .  
  
<Pluto> dbo:discovered "1930" .  
  
<Pluto> dbo:discoverer <Clyde_Tombaugh> .
```