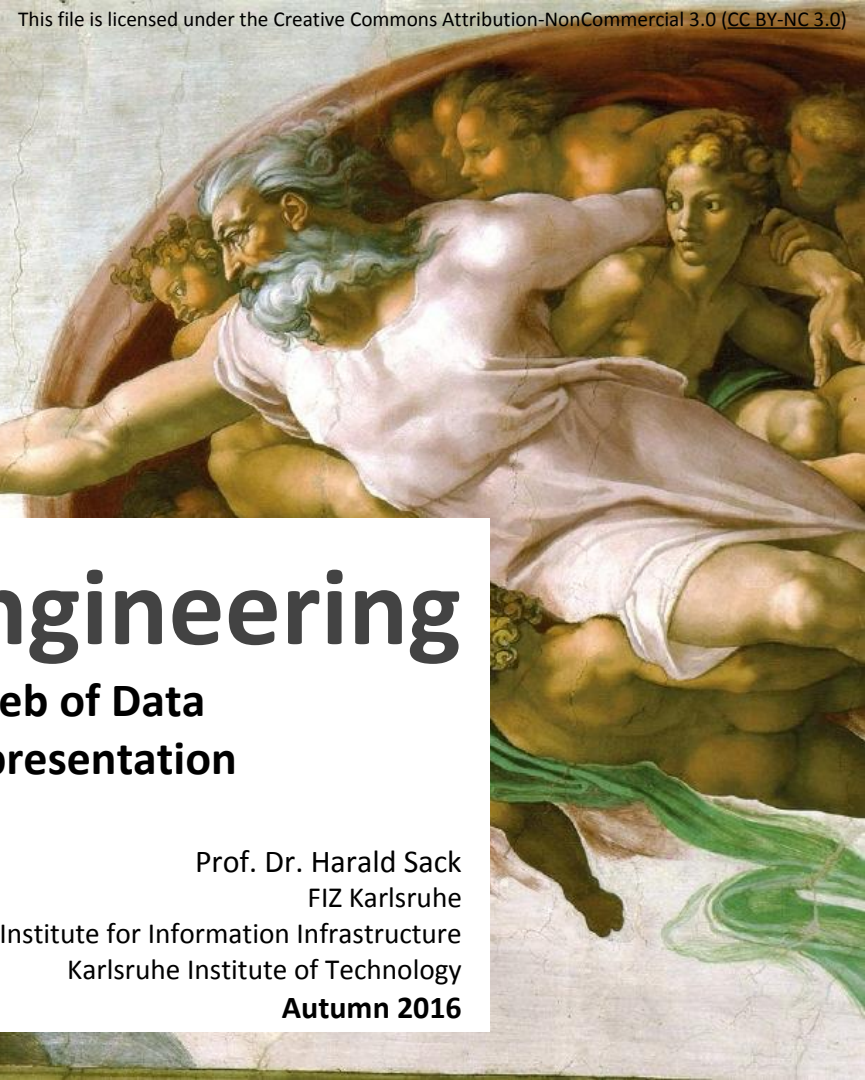




Lecture 1: Linked Data and the Web of Data

1.3 Towards a Universal Data Representation

1.3 Towards a Universal Data Representation



Karlsruher Institut für Technologie



Leibniz Institute for Information Infrastructure
Karlsruhe Institute of Technology
Autumn 2016

Karlsruhe Institute of Technology
Autumn 2016

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

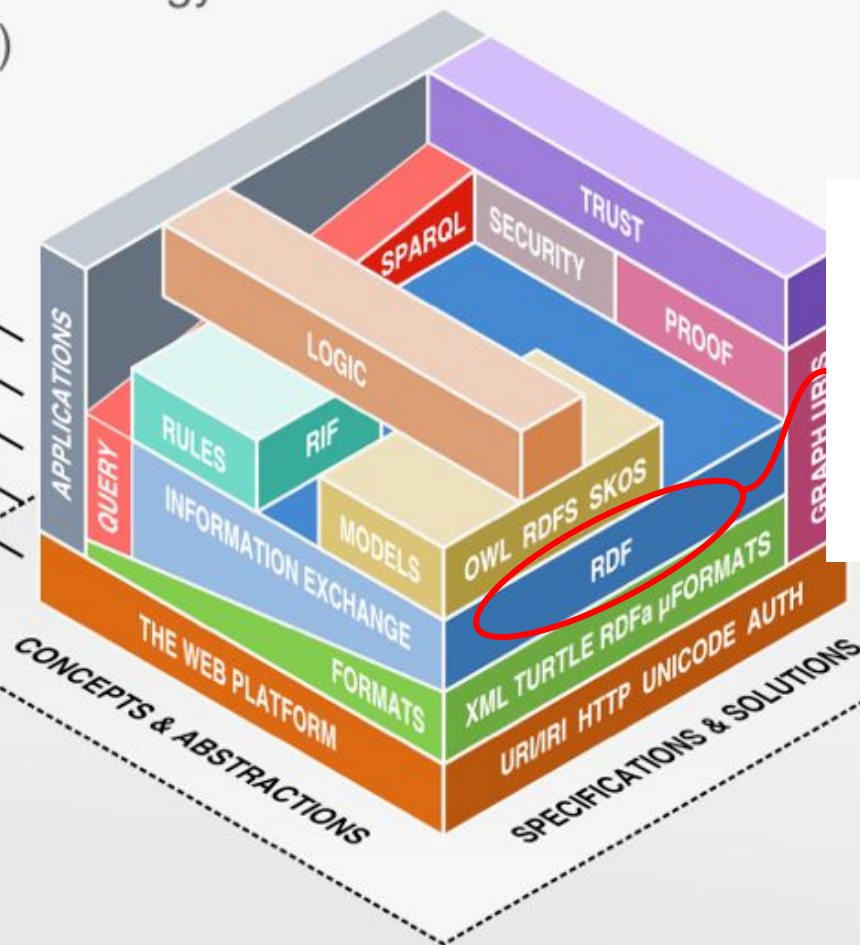
Standardized information exchange is key

Formats are necessary, but not too important

The Semantic Web is based on the Web

Linked Data uses a small selection of technologies

LINKED DATA



Resource
Description
Framework
(RDF)

Knowledge Representation

...a simple example

- How do I represent the following fact:
“Pluto has been discovered in 1930”?

Pluto : Planet
discovered = 1930

UML instance

```
<a href="http://en.wikipedia.org/wiki/Pluto">  
  Pluto  
</a> has been discovered in 1930.
```

HTML

```
<planet name = "Pluto" discovered="1930" />
```

XML



Knowledge Representation

...a simple example

- How do I represent the following fact:
“Pluto has been discovered in 1930” in **XML**?

```
<discovered>  
  <discovery>Pluto</discovery>  
  <year>1930</year>  
</discovered>
```

```
<planet name = "Pluto">  
  <yearDiscovered>1930</yearDiscovered>  
</planet>
```

```
<planet name = "Pluto" discovered="1930" />
```



is there a unique (intuitive) way to model knowledge (in XML)?

Knowledge Representation

...with XML?

- In XML successful communication of information requires translation among different XML serializations

```
<discovered>  
  <discovery>Pluto</discovery>  
  <year>1930</year>  
</discovered>
```

XML Schema A

XSLT Transformation

```
<xsl:stylesheet version="1.0"  
  xmlns:xsl="http://....Transform" >  
  <xsl:template match="/">  
    ....  
  </xsl:template>  
</xsl:stylesheet>
```

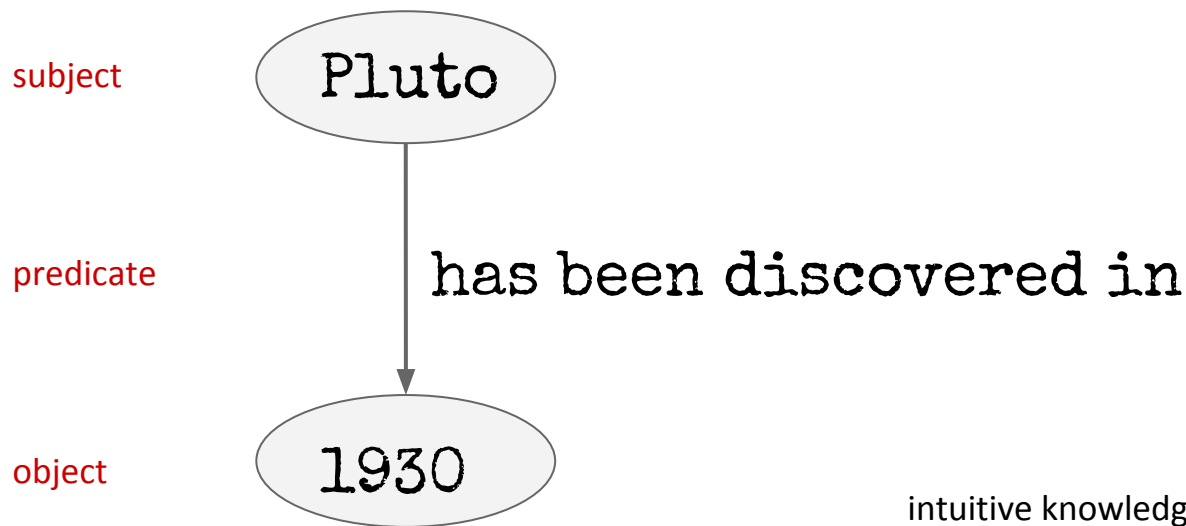
XML Schema B

```
<planet name = "Pluto" discovered="1930" />
```

Knowledge Representation

...a simple example

- How do I represent the following fact:
“Pluto has been discovered in 1930” in an intuitive way?



intuitive knowledge representation with a **directed graph**



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

subject

Pluto

URI

predicate

has been discovered in

URI

object

1930

URI or Literal



Resource Description Framework

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

Subject + Property + Object / Value

URI

URI

URI / Literal

RDF Building Blocks

N-Triples Serialization

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

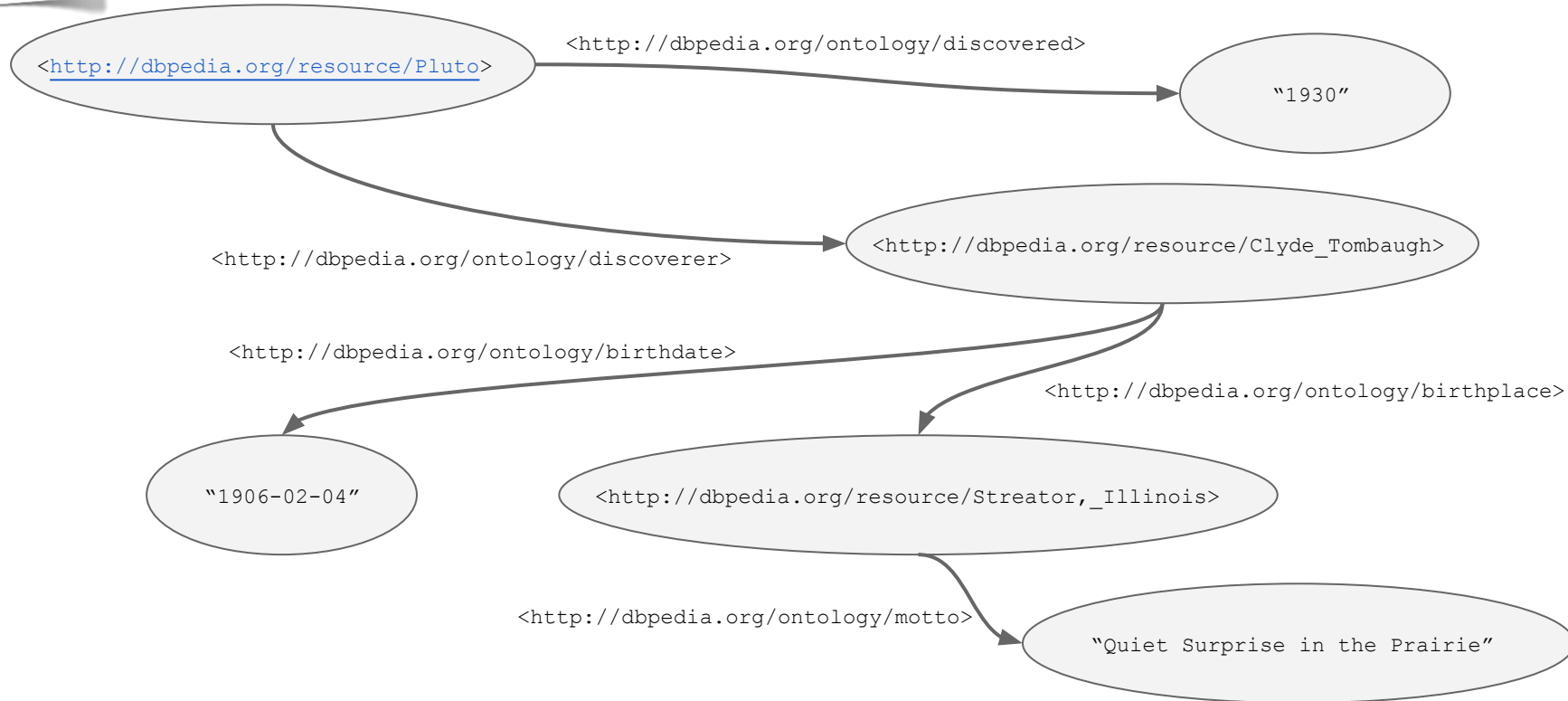


graph
representation



Resource Description Framework

From Triple to Knowledge Graph





Resource Description Framework

From Triple to Knowledge Graph

<code><http://dbpedia.org/resource/Pluto></code>	<code><http://dbpedia.org/ontology/discovered></code>	<code>"1930"</code>
<code><http://dbpedia.org/resource/Pluto></code>	<code><http://dbpedia.org/ontology/discoverer></code>	<code><http://dbpedia.org/resource/Clyde_Tombaugh></code>
<code><http://dbpedia.org/resource/Pluto></code>	<code><http://www.w3.org/1999/02/22-rdf-syntax-ns#type></code>	<code><http://dbpedia.org/ontology/CelestialBody></code>
<code><http://dbpedia.org/resource/Pluto></code>	<code><http://www.w3.org/1999/02/22-rdf-syntax-ns#type></code>	<code><http://schema.org/place></code>
...	...	...
<code><http://dbpedia.org/resource/Clyde_Tombaugh></code>	<code><http://dbpedia.org/ontology/birthdate></code>	<code>"1906-02-04"</code>
<code><http://dbpedia.org/resource/Clyde_Tombaugh></code>	<code><http://dbpedia.org/ontology/birthplace></code>	<code><http://dbpedia.org/resource/Streator,_Illinois></code>
...	...	...
<code><http://dbpedia.org/resource/Streator,_Illinois></code>	<code><http://dbpedia.org/ontology/motto></code>	<code>"Quiet Surprise in the Prairie"</code>
<code><http://dbpedia.org/resource/Streator,_Illinois></code>	<code><http://www.w3.org/2003/01/geo/wgs84_pos#lat></code>	<code>"41.120834"^^xsd:float</code>
<code><http://dbpedia.org/resource/Streator,_Illinois></code>	<code><http://www.w3.org/2003/01/geo/wgs84_pos#long></code>	<code>"-88.835281"^^xsd:float</code>
...	...	...
Subject	Property	Object

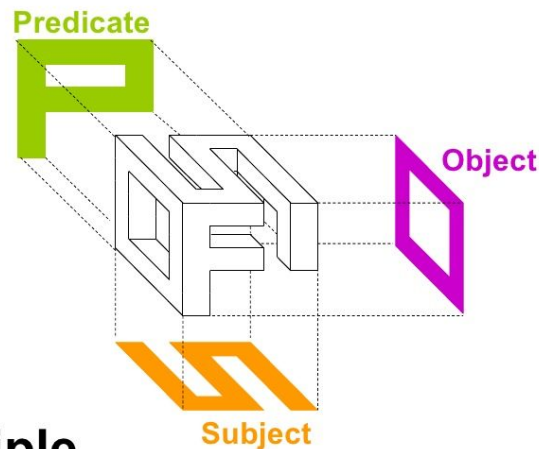
RDF Triples



Resource Description Framework

RDF is a Triple Model

i.e. every piece of knowledge is broken down into
(**subject** , **predicate** , **object**)

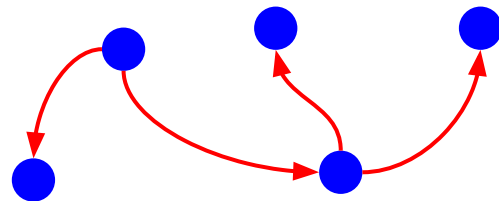


a triple
the RDF atom

http://www.slideshare.net/fabien_gandon

RDF is a Graph Model

i.e. every piece of knowledge is interpreted as
(**vertex** , **edge** , **vertex**)





Resource Description Framework

From Triple to Knowledge Graph

```
<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> .
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...
...
...

<http://dbpedia.org/resource/Streator,Illinois> <http://dbpedia.org/ontology/motto> "Quiet Surprise in the Prairie" .
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<http://dbpedia.org/resource/Streator,Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#long> "-88.835281"^^xsd:float .
...
...
...
```

Individuals (Entities)



Resource Description Framework

From Triple to Knowledge Graph

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

Classes



Resource Description Framework

From Triple to Knowledge Graph

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

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...
...
...
```

Literals



Resource Description Framework

From Triple to Knowledge Graph

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...
...
...
```

Properties



Resource Description Framework

From Triple to Knowledge Graph

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...
...
...
```

Vocabularies / Ontologies

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

Most apps use only a subset of the stack

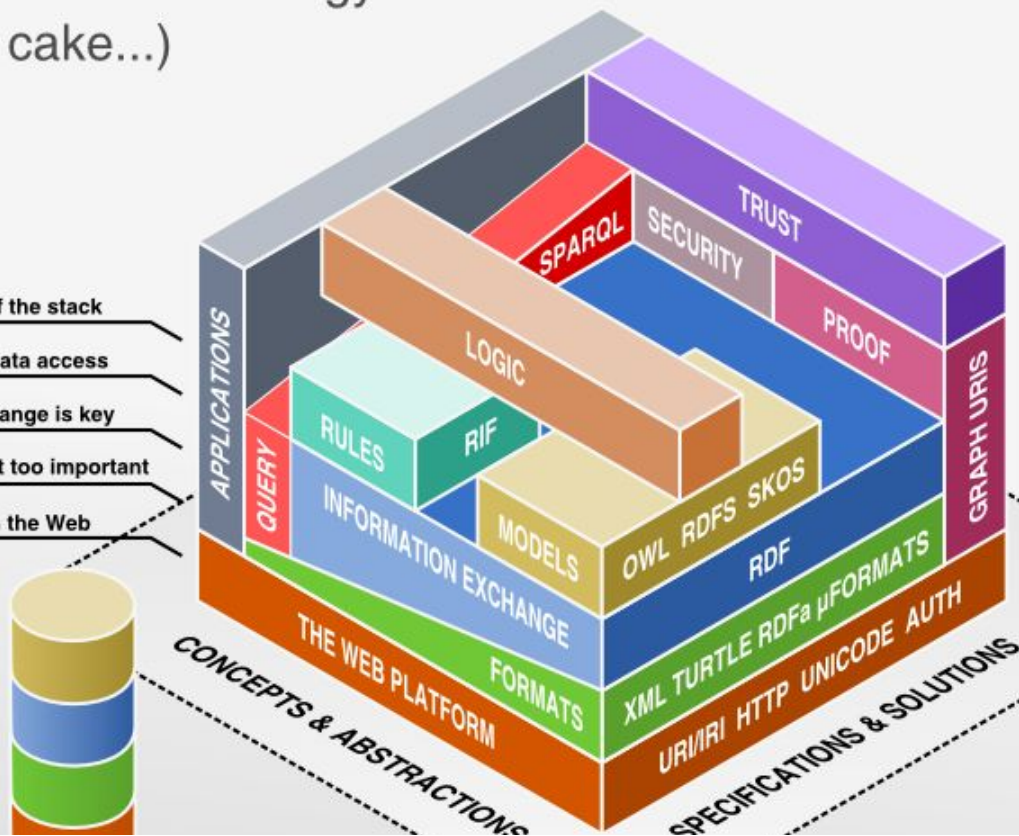
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Linked Data uses a small selection of technologies



Next: 04 - Semantic Web Technology

OpenHPI - Course Linked Data Engineering - Lecture 1: Linked Data and the Web of Data