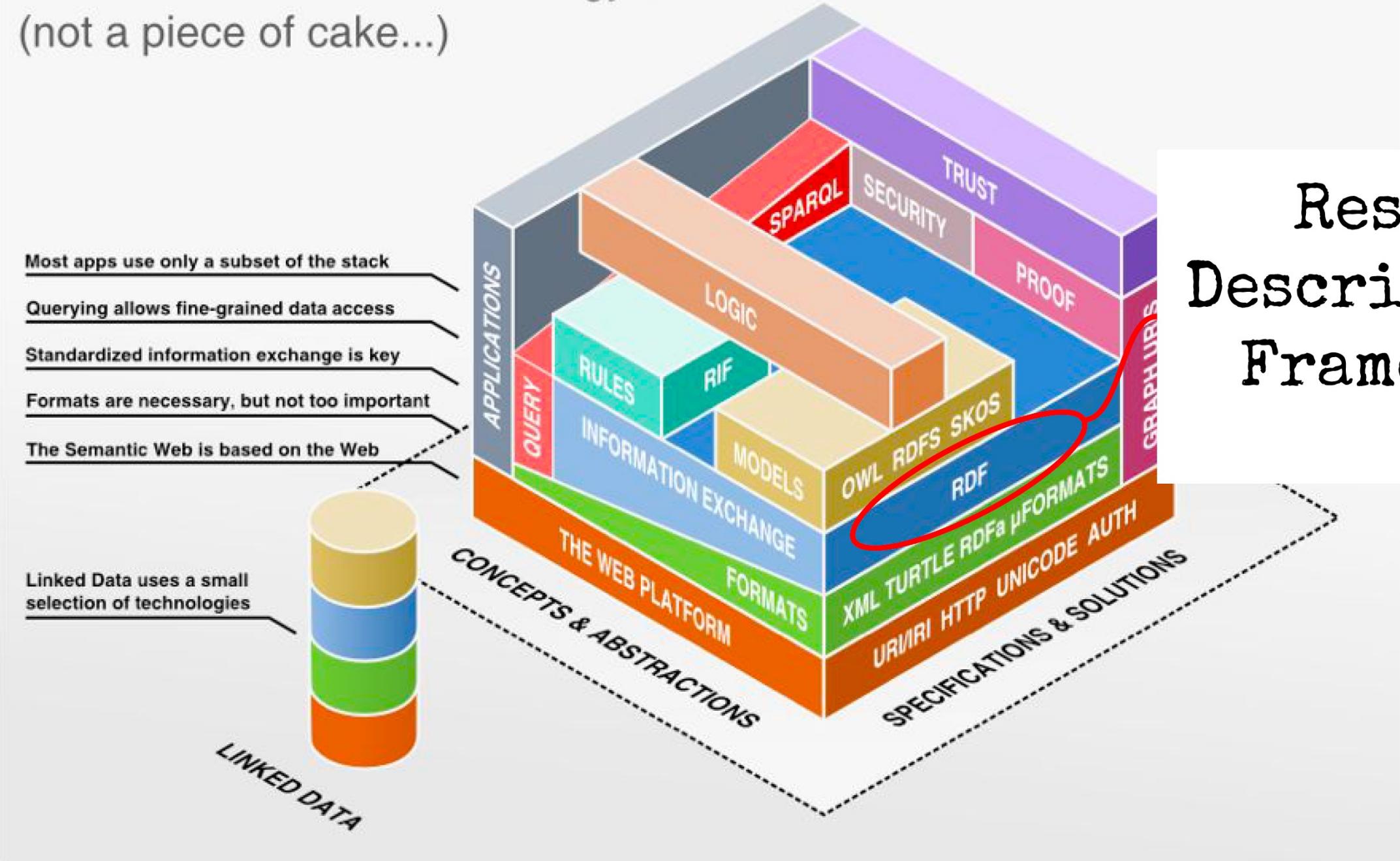


# The Semantic Web Technology Stack (not a piece of cake...)

## 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

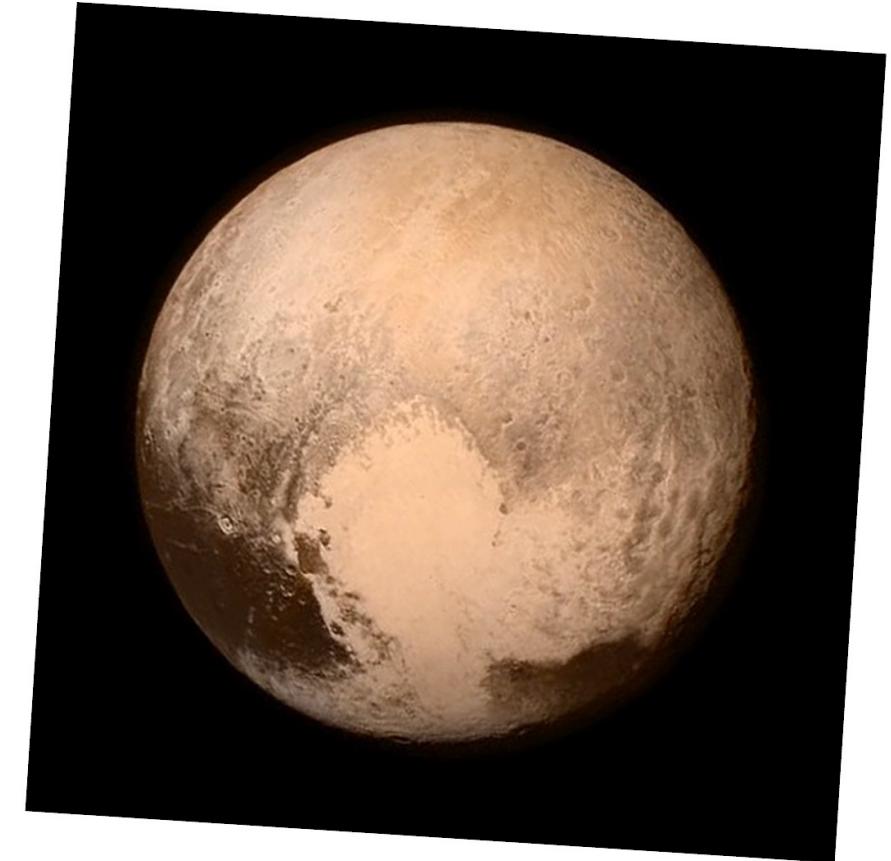
UML instance

```
<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>
```

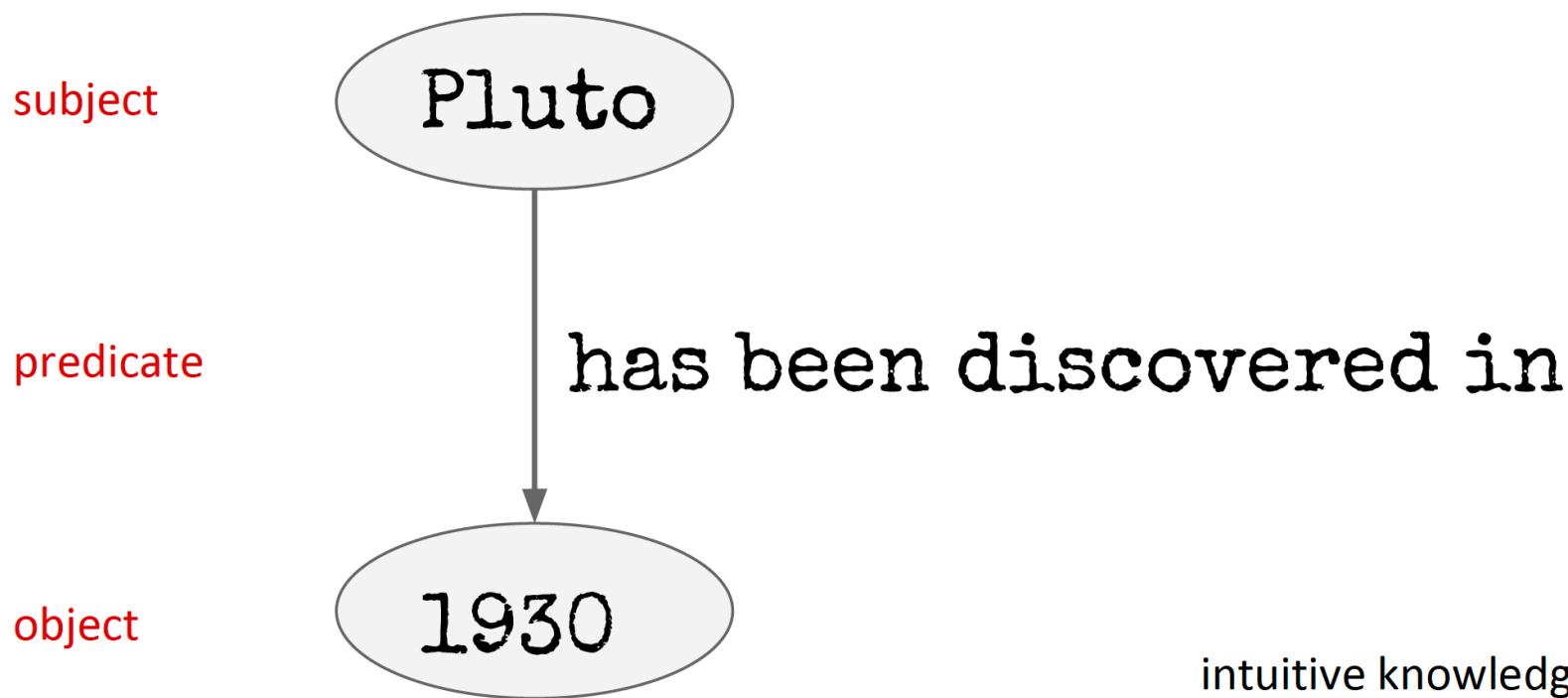
XML Schema B

```
<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?

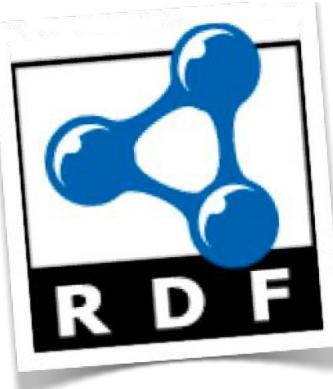


intuitive knowledge representation with a **directed graph**

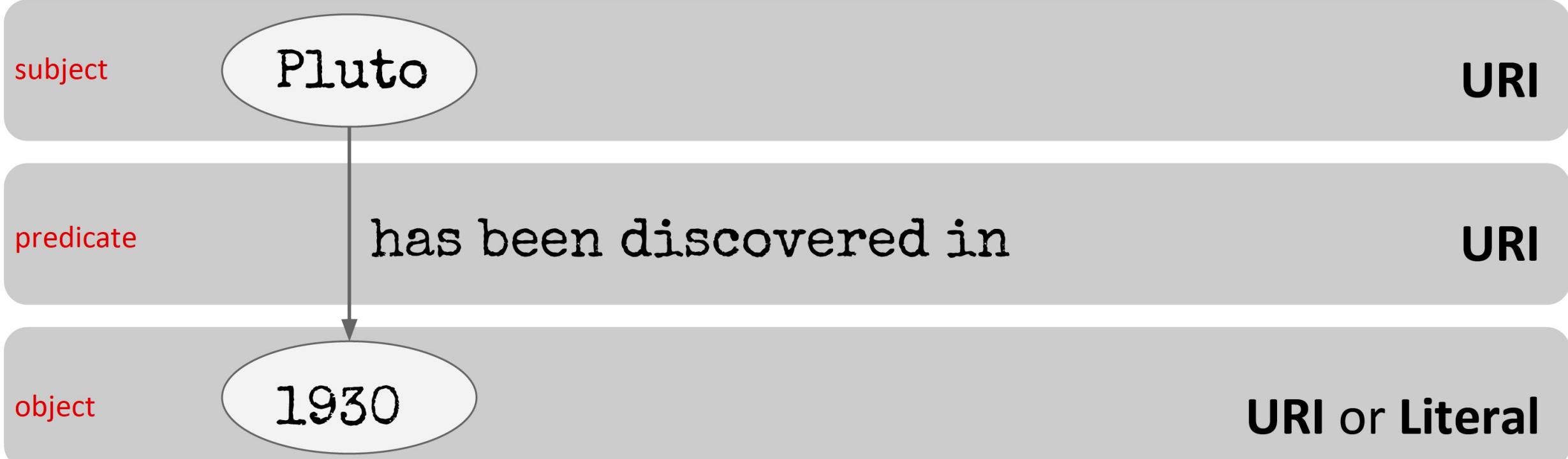


# Resource Description Framework

- **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





# 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" .

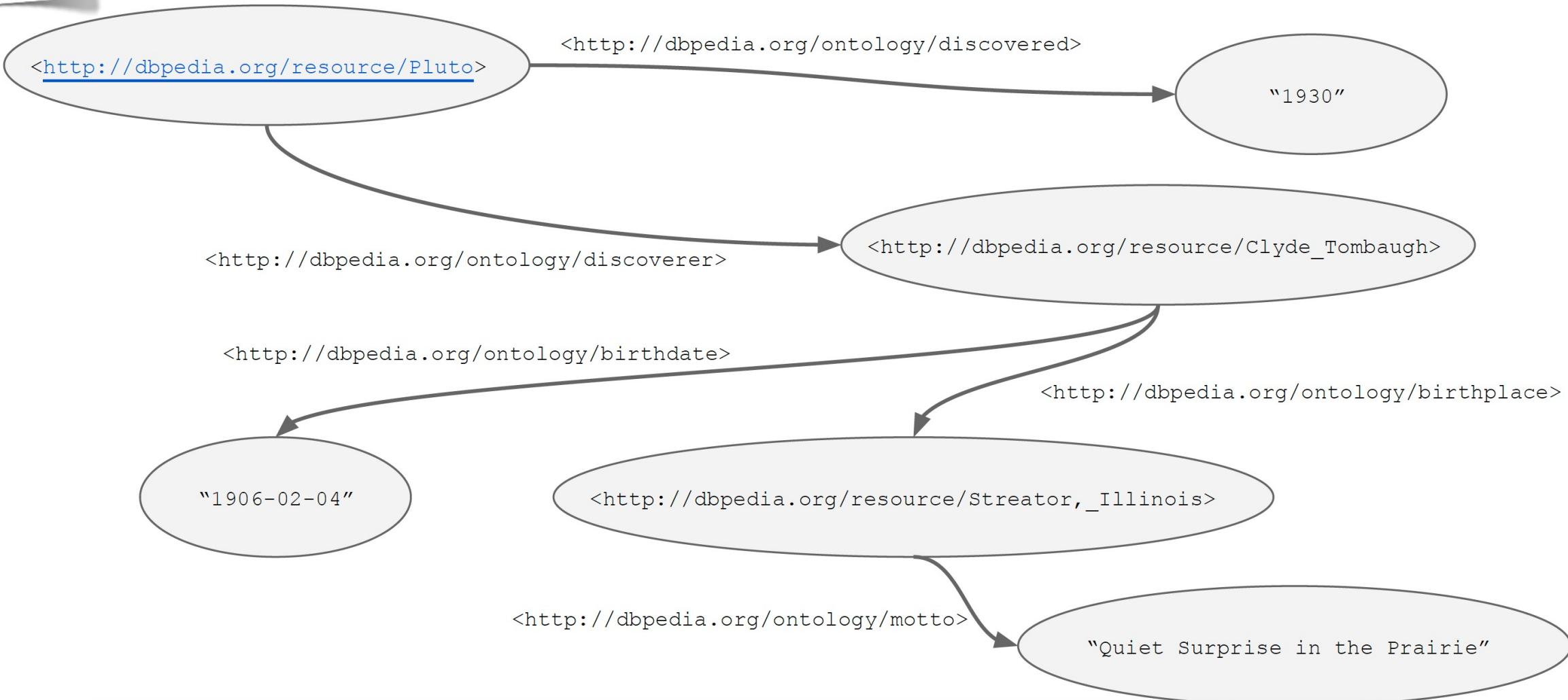


graph  
representation



# Resource Description Framework

## From Triple to Knowledge Graph





# 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> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://dbpedia.org/ontology/CelestialBody> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.org/place> .
```

...

...

...

```
<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthdate> "1906-02-04" .  
<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthplace> <http://dbpedia.org/resource/Streator,_Illinois> .
```

...

...

...

```
<http://dbpedia.org/resource/Streator,_Illinois> <http://dbpedia.org/ontology/motto> "Quiet Surprise in the Prairie" .  
<http://dbpedia.org/resource/Streator,_Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#lat> "41.120834"^^xsd:float .  
<http://dbpedia.org/resource/Streator,_Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#long> "-88.835281"^^xsd:float .
```

...

...

...

Subject

Property

Object

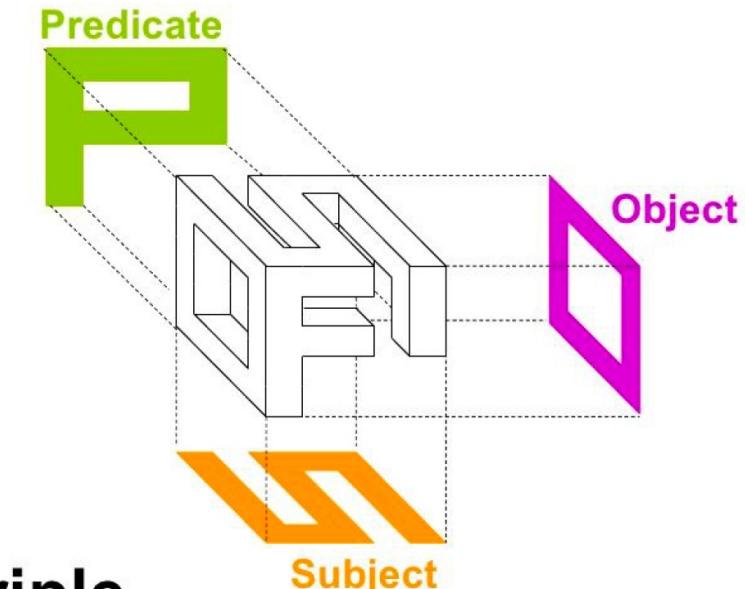
RDF Triples



# Resource Description Framework

RDF is a **Triple Model**

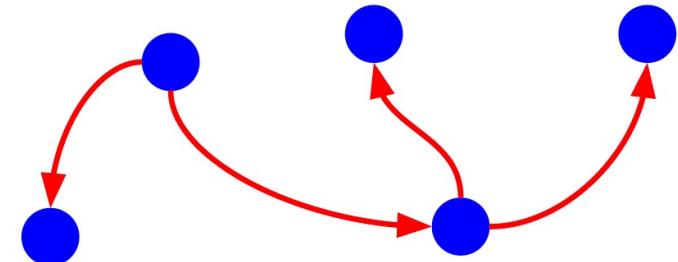
i.e. every piece of knowledge is broken down into  
( **subject** , **predicate** , **object** )



[http://www.slideshare.net/fabien\\_gandon](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> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://dbpedia.org/ontology/CelestialBody> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.org/place> .
```

...

...

...

```
<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthdate> "1906-02-04" .  
<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthplace> <http://dbpedia.org/resource/Streator,_Illinois> .
```

...

...

...

```
<http://dbpedia.org/resource/Streator,_Illinois> <http://dbpedia.org/ontology/motto> "Quiet Surprise in the Prairie" .  
<http://dbpedia.org/resource/Streator,_Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#lat> "41.120834"^^xsd:float .  
<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" .  
<http://dbpedia.org/resource/Pluto> <http://dbpedia.org/ontology/discoverer> <http://dbpedia.org/resource/Clyde_Tombaugh> .  
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<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.org/place> .
```

...

...

...

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<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthdate> "1906-02-04" .  
<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthplace> <http://dbpedia.org/resource/Streator,_Illinois> .
```

...

...

...

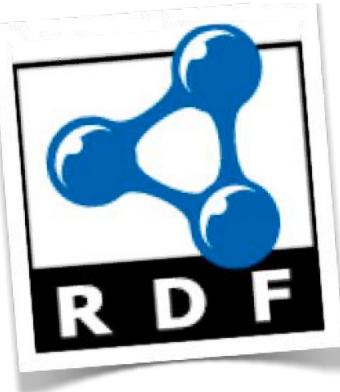
```
<http://dbpedia.org/resource/Streator,_Illinois> <http://dbpedia.org/ontology/motto> "Quiet Surprise in the Prairie" .  
<http://dbpedia.org/resource/Streator,_Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#lat> "41.120834"^^xsd:float .  
<http://dbpedia.org/resource/Streator,_Illinois> <http://www.w3.org/2003/01/geo/wgs84_pos#long> "-88.835281"^^xsd:float .
```

...

...

...

Classes



# 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/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.org/place> .  
...  
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<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthdate> "1906-02-04" .  
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...  
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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 .  
...  
...  
...
```

Literals



# 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> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://dbpedia.org/ontology/CelestialBody> .  
<http://dbpedia.org/resource/Pluto> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.org/place> .
```

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<http://dbpedia.org/resource/Clyde_Tombaugh> <http://dbpedia.org/ontology/birthplace> <http://dbpedia.org/resource/Streator,_Illinois> .
```

...

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...

```
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```

...

...

...

Properties



# Resource Description Framework

## From Triple to Knowledge Graph

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

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<<http://dbpedia.org/resource/Pluto>> <<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>> <<http://schema.org/place>> .

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...

<[http://dbpedia.org/resource/Clyde\\_Tombaugh](http://dbpedia.org/resource/Clyde_Tombaugh)> <<http://dbpedia.org/ontology/birthdate>> "1906-02-04" .

<[http://dbpedia.org/resource/Clyde\\_Tombaugh](http://dbpedia.org/resource/Clyde_Tombaugh)> <<http://dbpedia.org/ontology/birthplace>> <[http://dbpedia.org/resource/Streator,\\_Illinois](http://dbpedia.org/resource/Streator,_Illinois)> .

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<[http://dbpedia.org/resource/Streator,\\_Illinois](http://dbpedia.org/resource/Streator,_Illinois)> <[http://www.w3.org/2003/01/geo/wgs84\\_pos#lat](http://www.w3.org/2003/01/geo/wgs84_pos#lat)> "41.120834"^^xsd:float .

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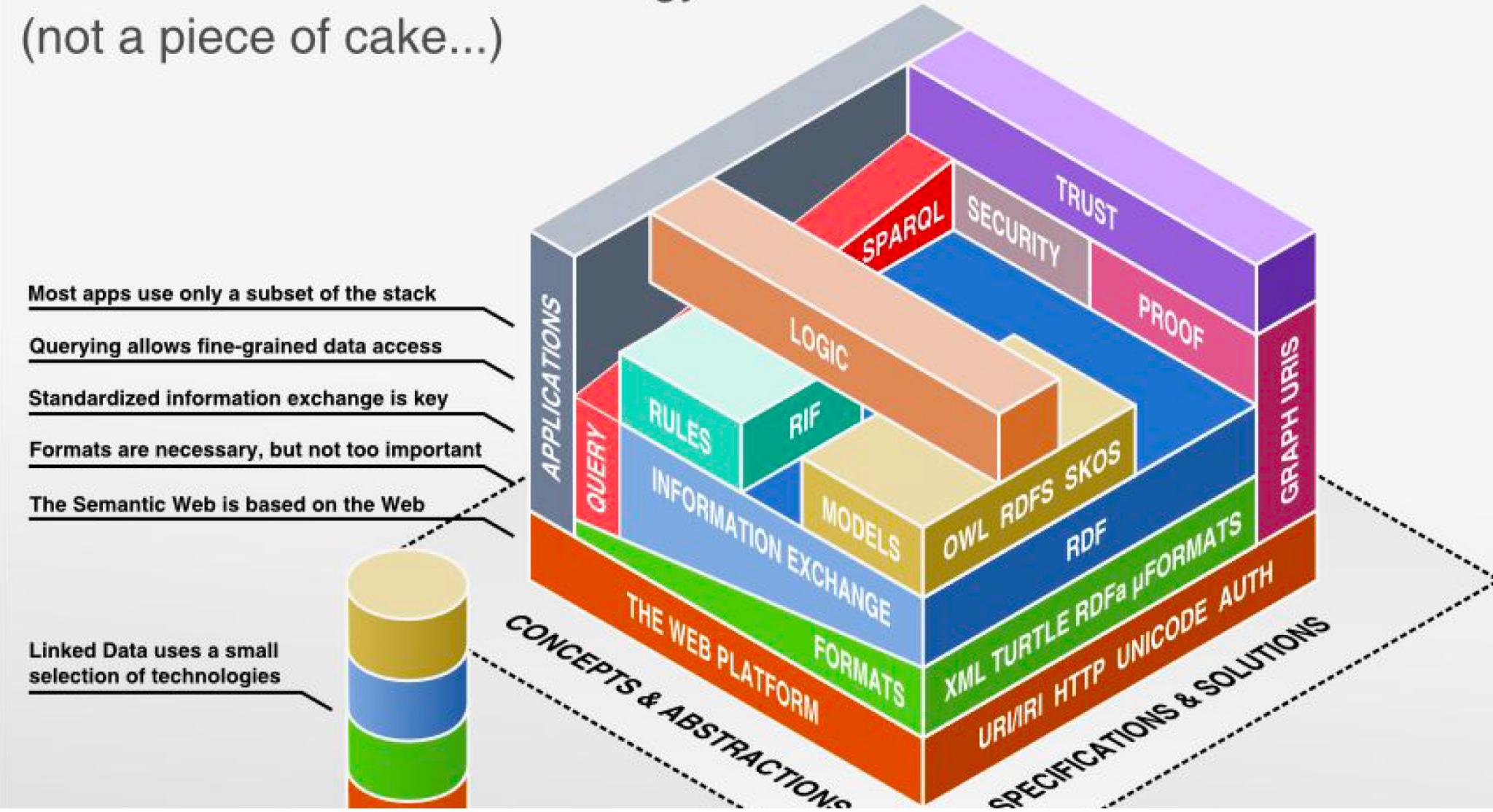
...

...

...

Vocabularies / Ontologies

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



## Next: 04 - Semantic Web Technology