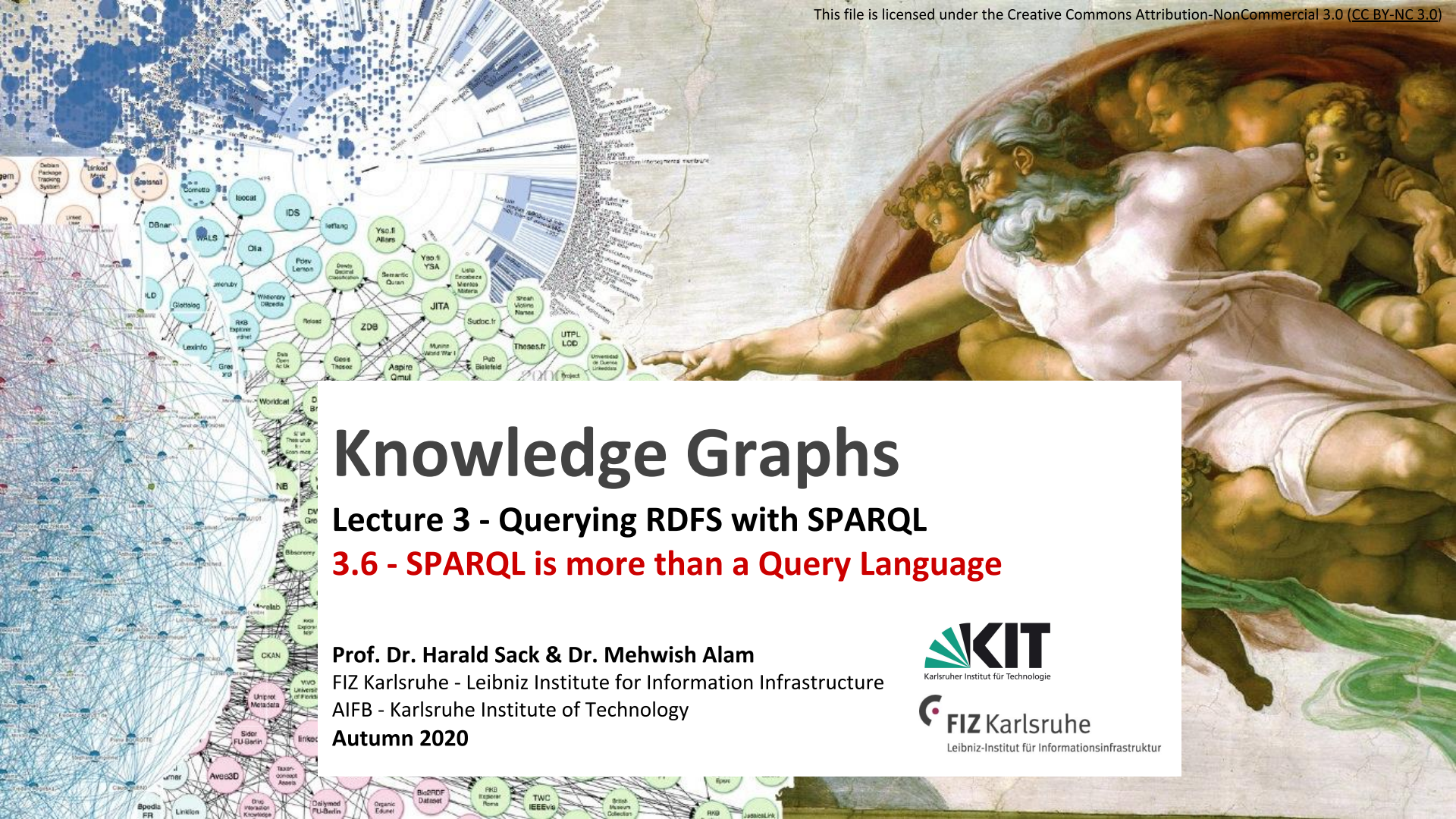


Knowledge Graphs

Lecture 3 - Querying RDFS with SPARQL

3.6 - SPARQL is more than a Query Language

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

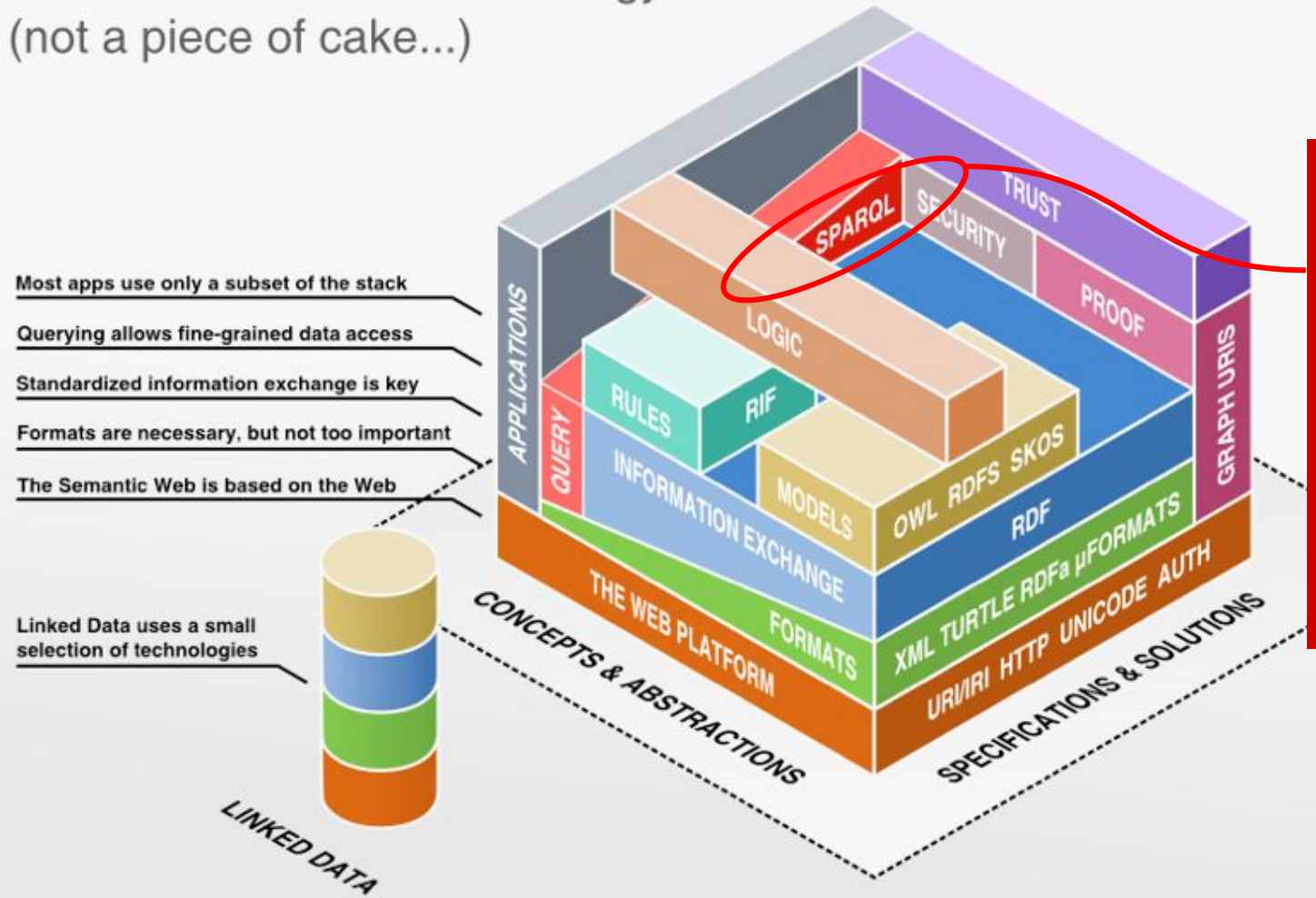
Karlsruher Institut für Technologie

FIZ Karlsruhe
Leibniz-Institut für Informationsinfrastruktur

Knowledge Graphs

Lecture 3: Querying RDF(S) with SPARQL

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



USE **SPARQL** and QUERY ON

[1,2]

SPARQL - A Query Language for RDF

- **SPARQL P**rotocol **a**nd **R**DF **Q**uery **L**anguage is
  - a **Query Language** for RDF graph traversal (*SPARQL Query Language Specification*)
  - a **Protocol Layer**, to use SPARQL via http (*SPARQL Protocol for RDF Specification*)
  - an **XML Output Format Specification** for SPARQL queries (*SPARQL Query XML Results Format*)

SPARQL Result Format

- SPARQL results are given as well formed and valid XML documents.

```
<?xml version="1.0"?>
<sparql xmlns="http://www.w3.org/2005/sparql-results#">
 ...
</sparql>
```

- In a **<head>** element all variables of the SPARQL query are listed.

```
<head>
    <variable name="x"/>
    <variable name="hpage"/>
    <variable name="name"/>
    <variable name="mbox"/>
    <variable name="blurb"/>
</head>
```

SPARQL Result Format

- For each SPARQL Query result exists a **<result>** element.

```
<?xml version="1.0"?>
<sparql xmlns="http://www.w3.org/2005/sparql-results#">
  <head>
    <variable name="x"/>
    ...
  </head>
  <results>
    <result>
      <binding name="x"> ... </binding>
      <binding name="hpage"> ... </binding>
    </result>

    <result> ... </result>
    ...
  </results>
</sparql>
```

single SPARQL query result

SPARQL Result Format

- Within a **<binding>** element a **<head>** variable is bound to a result.

```
<result>
      <binding name="x">
        <bnode>r2</bnode>
      </binding>
      <binding name="hpage">
        <uri>http://work.example.org/bob/</uri>
      </binding>
      <binding name="name">
        <literal xml:lang="en">Bob</literal>
      </binding>
      <binding name="age">
        <literal datatype="http://www.w3.org/2001/XMLSchema#integer">
         30
        </literal>
      </binding>
      <binding name="mbox">
        <uri>mailto:bob@work.example.org</uri>
      </binding>
    </result>
```

SPARQL - A Query Language for RDF

- **SPARQL P**rotocol **a**nd **R**DF **Q**uery **L**anguage is
  - a **Query Language** for RDF graph traversal (*SPARQL Query Language Specification*)
  - a **Protocol Layer**, to use SPARQL via http (*SPARQL Protocol for RDF Specification*)
  - an **XML Output Format Specification** for SPARQL queries (*SPARQL Query XML Results Format*)

SPARQL Protocol

- Method to query/respond of SPARQL queries via http
- A SPARQL URI consists out of 3 parts:
  (1) URL of a SPARQL endpoint (e.g. http://example.org/sparql)
  (2) RDF Graph(s) to be queried
  (optional, part of the query string,
  e.g. named-graph-uri=http://example.org/testrdf.rdf)
  (3) SPARQL query
  (part of the query string, e.g. query=SELECT...)

http://example.org/sparql?named-graph-uri=http%3A%2F%2Fexample.org%2Ftestrdf&
query=SELECT+%3Freview_graph+WHERE+%7B%0D%0A++GRAPH+%3Frev
iew_graph+%7B%0D%0A+++++%3Freview+rev%3Arating+10+.%0D%0A++%7D%0D%0A
%7D

SPARQL Protocol - Example

- Simple SPARQL query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX dbo: <http://dbpedia.org/ontology/>
SELECT ?author  ?work
WHERE {
       ?author rdf:type dbo:Writer ;
               dbo:notableWork ?work .
} LIMIT 100
```

- HTTP Trace of the SPARQL query

GET
http://dbpedia.org/sparql?default-graph-uri=http%3A%2F%2Fdbpedia.org&query=PREFIX+rdf%3A+%3Chttp%3A%2F%2Fwww.w3.org%2F1999%2F02%2F22-rdf-syntax-ns%23%3E%0D%0APREFIX+dbo%3A+%3Chttp%3A%2F%2Fdbpedia.org%2Fontology%2F%3E%0D%0ASELECT+%3Fauthor++%3Fwork%0D%0AWHERE+%7B%0D%0A+++++++%3Fauthor+rdf%3Atype+dbo%3AWriter+%3B%0D%0A+++++++++++++++dbo%3AnotableWork+%3Fwork+.%0D%0A%7D+LIMIT+100%0D%0A
Host: dbpedia.org
User-agent: Mozilla/5.0 …
Accept:text/html,application/xhtml+xml,application/xml

SPARQL Protocol - Example

- HTTP Trace of the SPARQL response

```
HTTP/1.1 200 OK
Date: Tue, 18 Aug 2015 09:55:07 GMT
Content-Type: application/sparql-results+xml; charset=UTF-8
Content-Length: 21055
Connection: keep-alive
Server: Virtuoso/07.20.3214 (Linux) x86_64-redhat-linux-gnu  VDB
X-SPARQL-default-graph: http://dbpedia.org
...
<sparql xmlns="http://www.w3.org/2005/sparql-results#" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.w3.org/2001/sw/DataAccess/rf1/result2.xsd">
 <head>
  <variable name="author"/>
  <variable name="work"/>
 </head>
 <results distinct="false" ordered="true">
  <result>
   <binding name="author"><uri>http://dbpedia.org/resource/Ding_Ling</uri></binding>
   <binding name="work"><uri>http://dbpedia.org/resource/Miss_Sophia&#39;s_Diary</uri></binding>
  </result>
  …
</results>
</sparql>
```

SPARQL is not only a Query Language

- **SPARQL P**rotocol **a**nd **R**DF **Q**uery **L**anguage is
  - a **Query Language** for RDF graph traversal (*SPARQL Query Language Specification*)
  - a **Protocol Layer**, to use SPARQL via http (*SPARQL Protocol for RDF Specification*)
  - an **XML Output Format Specification** for SPARQL queries (*SPARQL Query XML Results Format*)

SPARQL is not only a Query Language

- In addition to `SELECT` queries SPARQL allows:
- **ASK**
  - Check whether there is at least one result
  - Result: true or false
  - Result is delivered as XML or JSON

```
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>

ASK
WHERE {
  ?author wdt:P106 wd:Q36180 ; #?author has occupation Writer
          wdt:P800 ?book .     #?author has notableWork ?book
  ?book wdt:P31 wd:Q571 .      #?book is a Book
}
```

- *Example:* Is there an author with a notable work?

WIKIDATA
query SPARQL endpoint

SPARQL is not only a Query Language

- In addition to `SELECT` queries SPARQL allows:
- **DESCRIBE**
  - Result: an RDF graph with data about resources
  - Result is RDF/XML or Turtle

```
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>

DESCRIBE ?author ?book
WHERE {
  ?author wdt:P106 wd:Q36180 ; #?author has occupation Writer
          wdt:P800 ?book .     #?author has notableWork ?book
  ?book wdt:P31 wd:Q571 .      #?book is a Book
}
```

- *Example:* Show all available data about authors and their notable works?

WIKIDATA
query SPARQL endpoint

SPARQL is not only a Query Language

- In addition to `SELECT` queries SPARQL allows:
- **CONSTRUCT**
  - Result: an RDF graph constructed from a template
  - Template: graph pattern with variables from the query pattern
  - Result is RDF/XML or Turtle

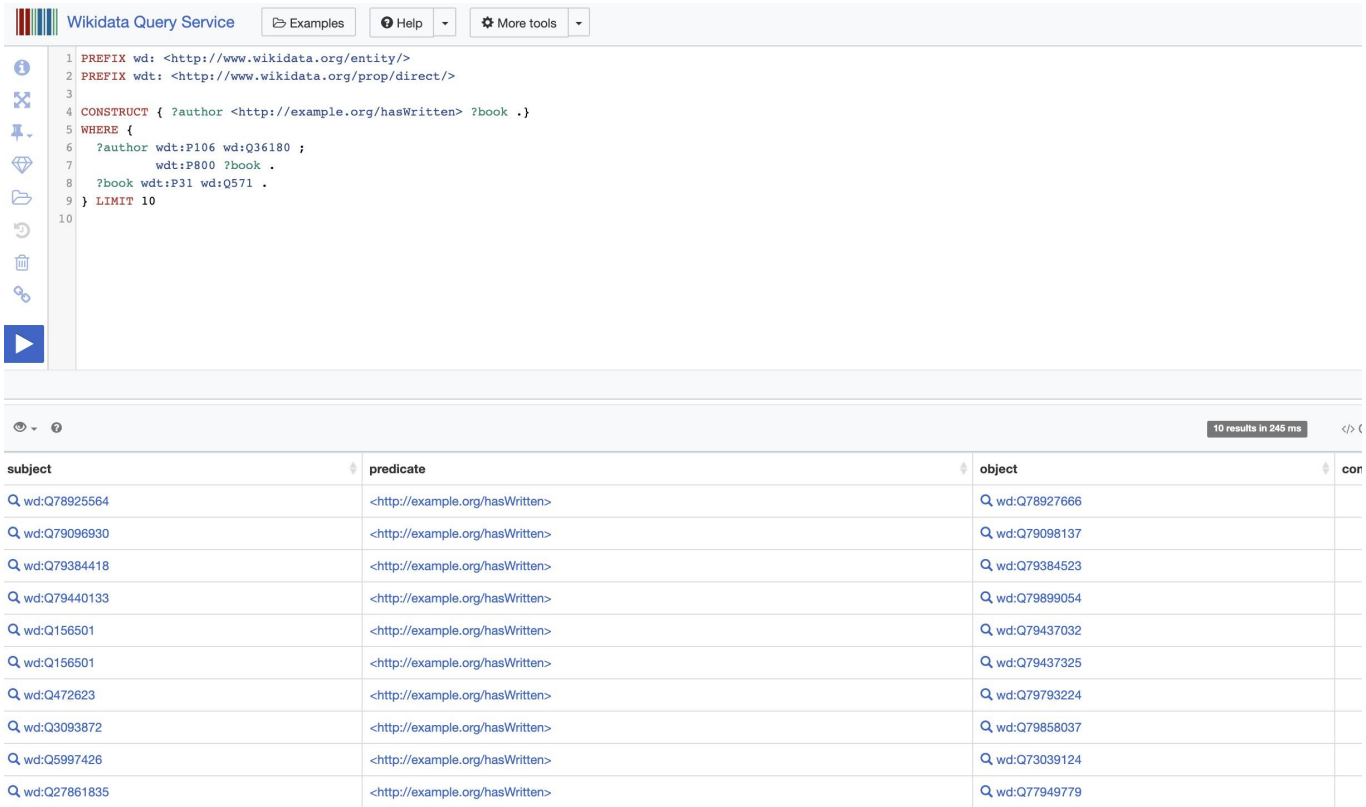
```
PREFIX wd: <http://www.wikidata.org/entity/>
PREFIX wdt: <http://www.wikidata.org/prop/direct/>

CONSTRUCT { ?author <http://example.org/hasWritten> ?book .}
WHERE {
  ?author wdt:P106 wd:Q36180 ;
          wdt:P800 ?book .
  ?book wdt:P31 wd:Q571 .
} LIMIT 10
```

- *Example:* Create new RDF triples for authors and their notable works?

WIKIDATA
query SPARQL endpoint

SPARQL is not only a Query Language

- *Example:* Create new RDF triples for authors and their notable works?

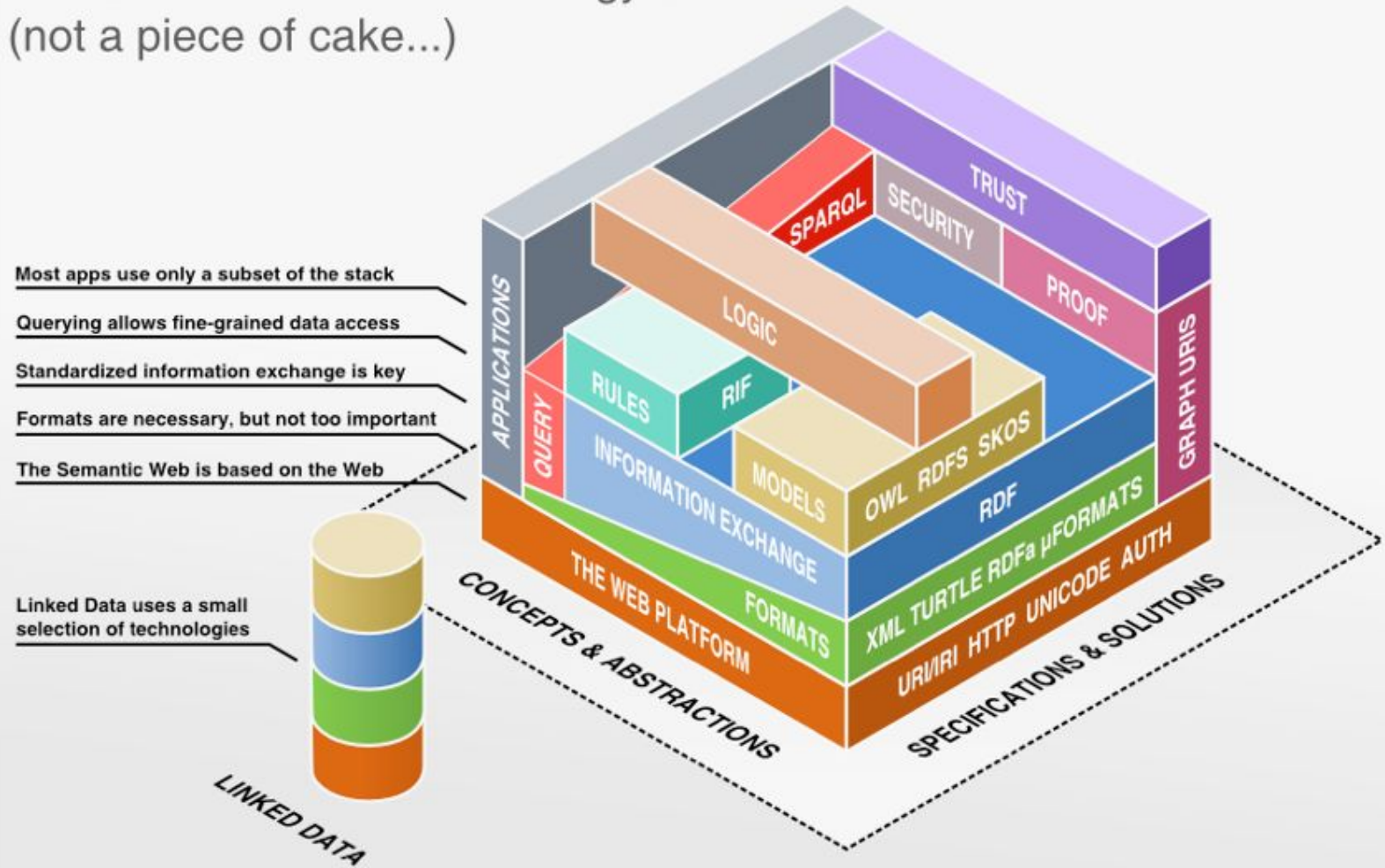


subject	predicate	object
wd:Q78925564	<http://example.org/hasWritten>	wd:Q78927666
wd:Q79096930	<http://example.org/hasWritten>	wd:Q79098137
wd:Q79384418	<http://example.org/hasWritten>	wd:Q79384523
wd:Q79440133	<http://example.org/hasWritten>	wd:Q79899054
wd:Q156501	<http://example.org/hasWritten>	wd:Q79437032
wd:Q156501	<http://example.org/hasWritten>	wd:Q79437325
wd:Q472623	<http://example.org/hasWritten>	wd:Q79793224
wd:Q3093872	<http://example.org/hasWritten>	wd:Q79858037
wd:Q5997426	<http://example.org/hasWritten>	wd:Q73039124
wd:Q27861835	<http://example.org/hasWritten>	wd:Q77949779

WIKIDATA

query SPARQL endpoint

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



[1]

Next Lecture...

Karlsruher Institut für Technologie
FIZ Karlsruhe
Leibniz Institute for Information Infrastructure

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] British Crown vector illustration, publicdomainvectors.org, [Public Domain]
  https://publicdomainvectors.org/en/free-clipart/British-Crown-vector-illustration/12150.html
- [3] WIkidata Logo, Planemad, [Public Domain]
  https://commons.wikimedia.org/wiki/File:Wikidata-logo-en.svg
- [4] Raphael, School of Athens, 1511, [Public Domain]
  https://commons.wikimedia.org/wiki/File:%22The_School_of_Athens%22_by_Raffaello_Sanzio_da_Urbino.jpg