



# Knowledge Graphs

## Lecture 2 – Basic Knowledge Graph Infrastructure

### 2.1 How to identify and access Things

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**FIZ Karlsruhe**

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### 2.1 How to Identify and Access Things

### 2.2 How to Represent Simple Facts with RDF

### 2.3 RDF Turtle Serialization

### 2.4 RDF Complex Data Structures

### 2.5 Model Building with RDFS

Excursion 1: RDF Reification and RDF\*

### 2.6 Logical Inference with RDF(S)

Excursion 2: RDFa – RDF and the Web

What is this?

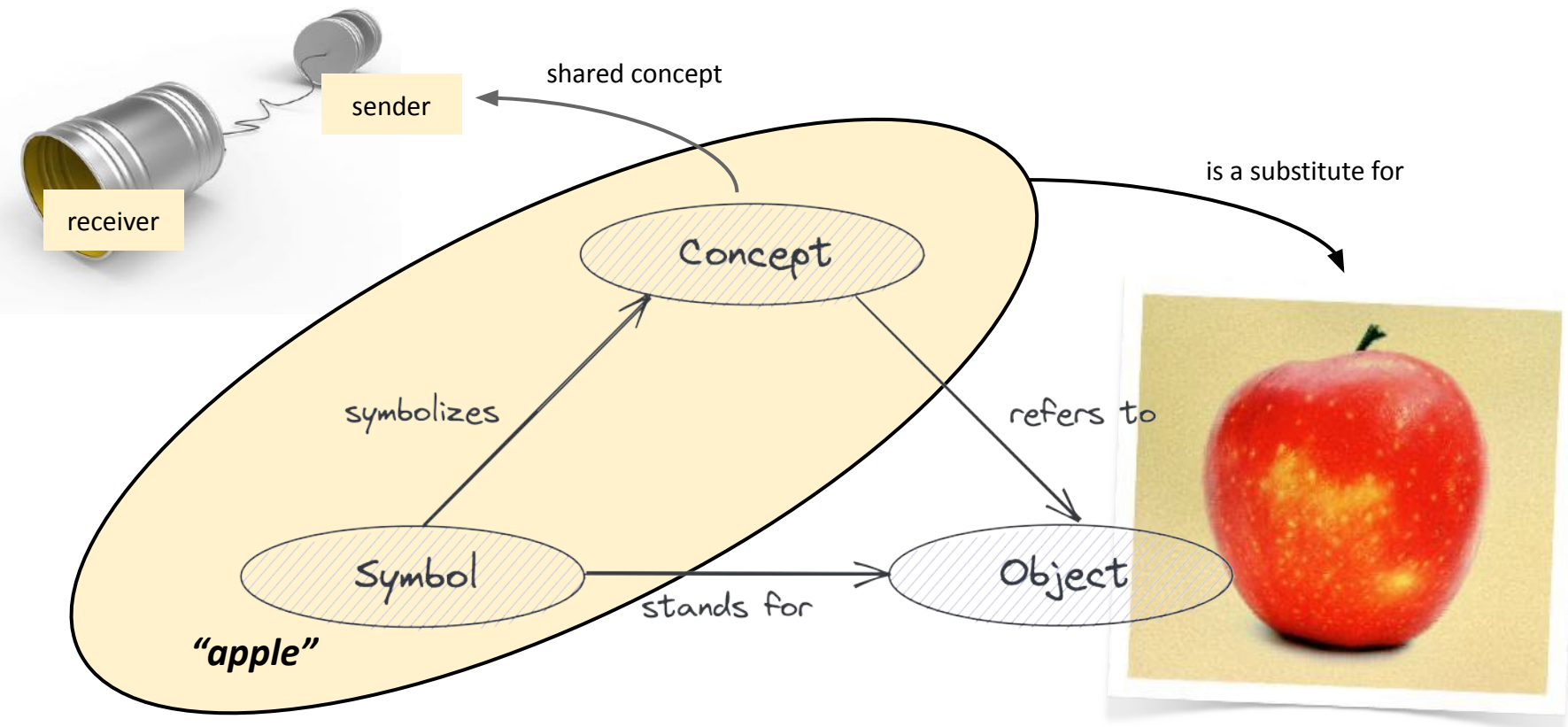






*Ceci n'est pas une pomme.*

# Semiotic Triangle



[2,3]

# Uniform Resource Identifier

- A **Uniform Resource Identifier (URI)** defines a simple and extensible schema for worldwide unique identification of abstract or physical resources (RFC 3986).
- An **Internationalized Resource Identifier (IRI)** extends the URI definition by expanding the set of permitted characters to most Unicode characters (RFC 3987).

`https://data.example.org/fruits/apples#this`



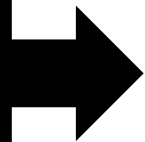
# Uniform Resource Identifier

- A **resource** can be every object with a clear identity (according to the context of the application)
  - e.g. web pages, books, locations, persons, relations among objects, abstract concepts, etc.
- The URI concept is already established in various domains, e.g.
  - the Web (URL),
  - books and publications (ISBN, ISSN, EAN),
  - Digital Object Identifier (DOI).

# URL

identify  
what exists  
on the Web

<https://www.mywebsite.org/>



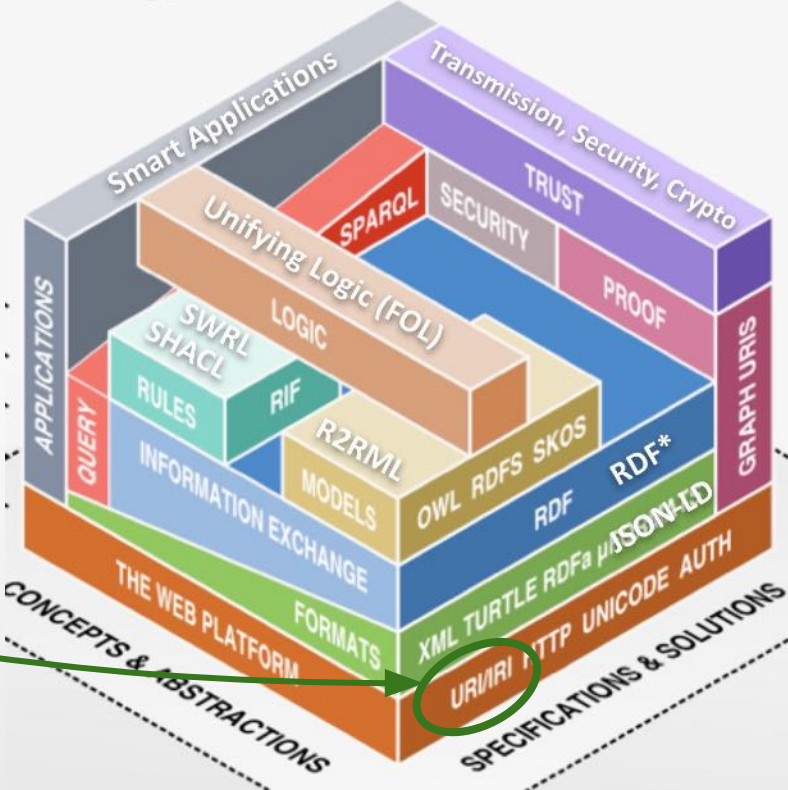
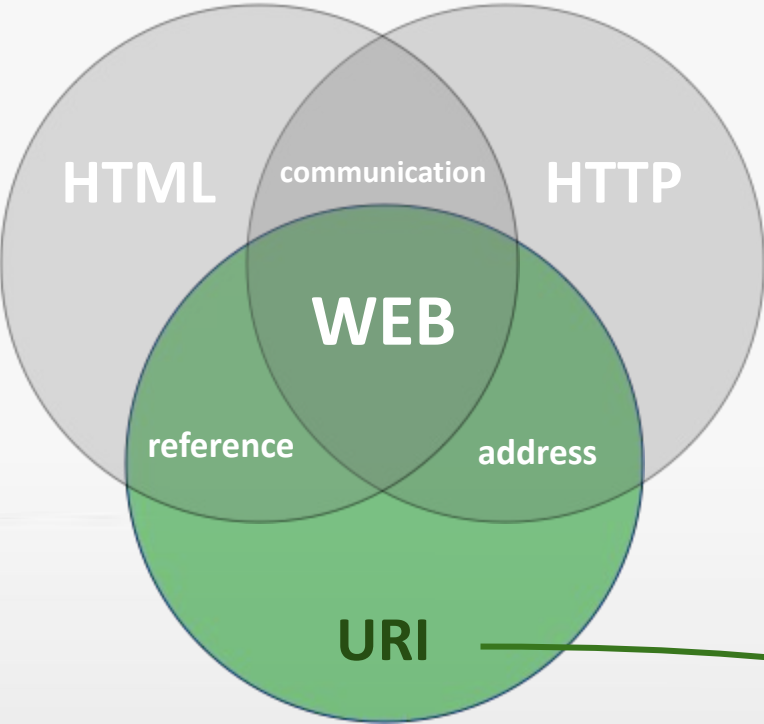
# URI

identify  
on the Web  
what exists

[https://www.mywebsite.org/harald\\_foaf.rdf#me](https://www.mywebsite.org/harald_foaf.rdf#me)



# Basic Architecture of the Web of Data



Would this be an appropriate URI?



<https://www.xyz.org/apple>

<https://www.xyz.org/Apfel>

<https://www.xyz.org/pomme>

<https://www.xyz.org/苹果>



# Would this be an appropriate URI?

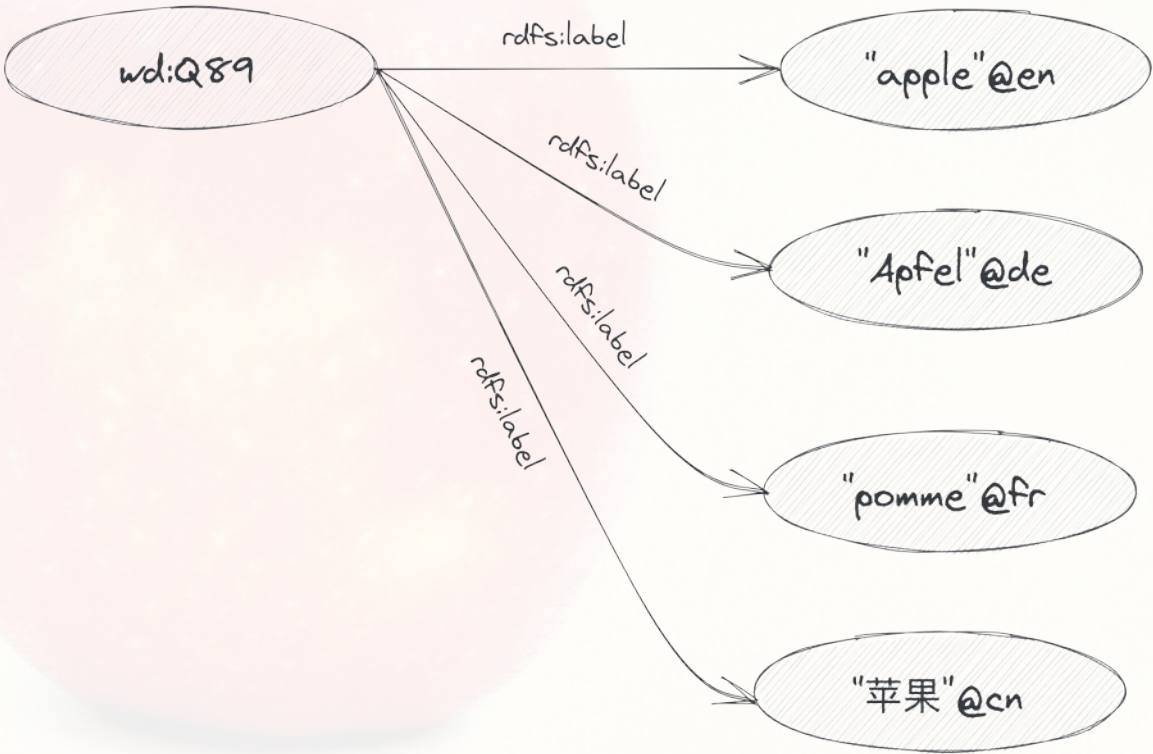


<https://www.wikidata.org/entity/Q312>



<https://www.wikidata.org/entity/Q89>

# Identification vs Lexicalization





URI

<https://www.wikidata.org/entity/Q89>

*“Apple” is **identified**  
by a URI.*

*identifies*

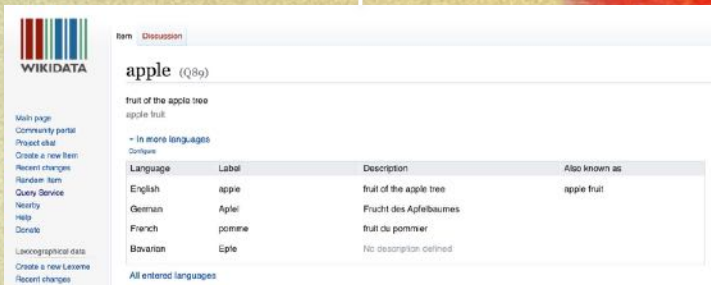
*describes*

**Designatum = Resource**

*represents (stands for)*

**Representation**

**Designator**



Language	Label	Description	Also known as
English	apple	fruit of the apple tree	apple fruit
German	Apfel	Frucht des Apfelbaumes	
French	pomme	fruit du pommier	
Bavarian	Epfel	No description defined	

*“Apple” is **described**  
(**designated**) by a web page.*

**Metadata:**

Content-type: text/html

**Data:**

```
<!DOCTYPE html>
<html class="client-nojs" lang="en" dir="ltr">
<head>
<meta charset="UTF-8"/>
<title>apple - Wikidata</title>
...
</html>
```

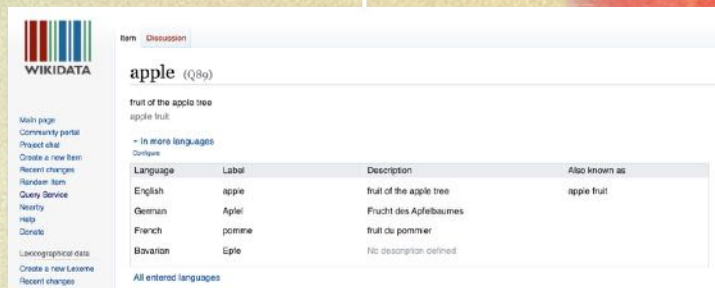
*“Apple” is **represented**  
via HTML code.*

# HTTP Content Negotiation

*describes*

**Designatum** = Resource

**Designator**



Language	Label	Description	Also known as
English	apple	fruit of the apple tree	apple fruit
German	Apfel	Frucht des Apfelbaumes	
French	pomme	fruit du pommier	
Bavarian	Epfel	No description defined	

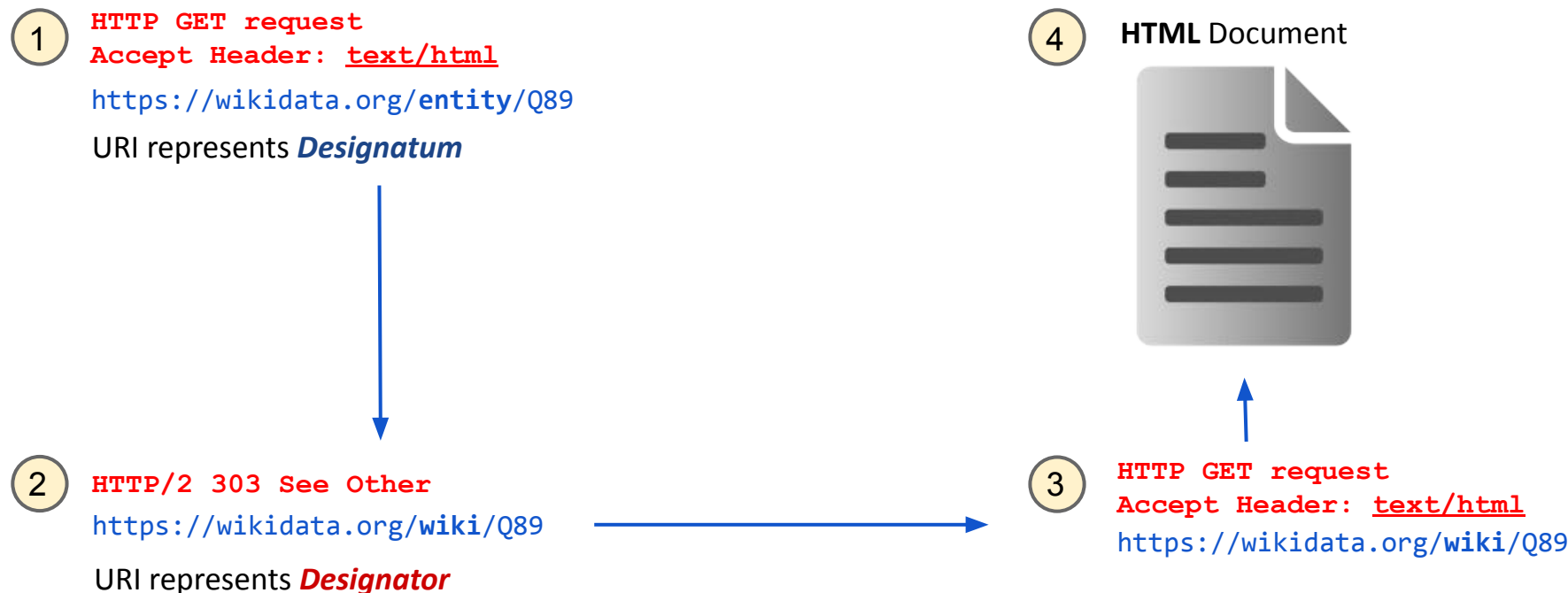
- **Designator** and **Designatum** are separate things.
- Therefore, they should have **different URIs**.

▶ **HTTP CONTENT NEGOTIATION**

# HTTP Content Negotiation

## Let's try an example:

I want to have **information** about “the Apple” from Wikidata.





# HTTP Content Negotiation

Let's try another example:

I want to have **machine understandable information** about “the Apple” from Wikidata.

- 1 HTTP GET request  
Accept Header: text/turtle  
<https://wikidata.org/entity/Q89>  
URI represents *Designatum*



- 2 HTTP/2 303 See Other  
<https://wikidata.org/wiki/Special:EntityData/Q89.ttl>  
URI represents *Designator*



- 4 RDF Document



Turtle is a  
way to encode  
RDF

- 3 HTTP GET request  
Accept Header: text/turtle  
<https://wikidata.org/wiki/Special:EntityData/Q89.ttl>



# HTTP Content Negotiation

## Let's try it ourselves:

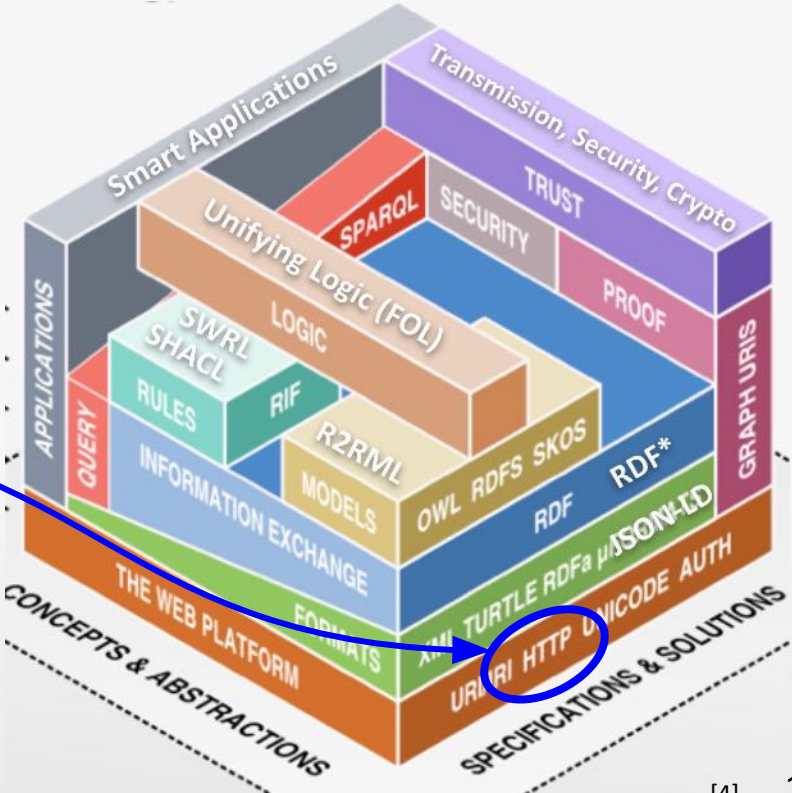
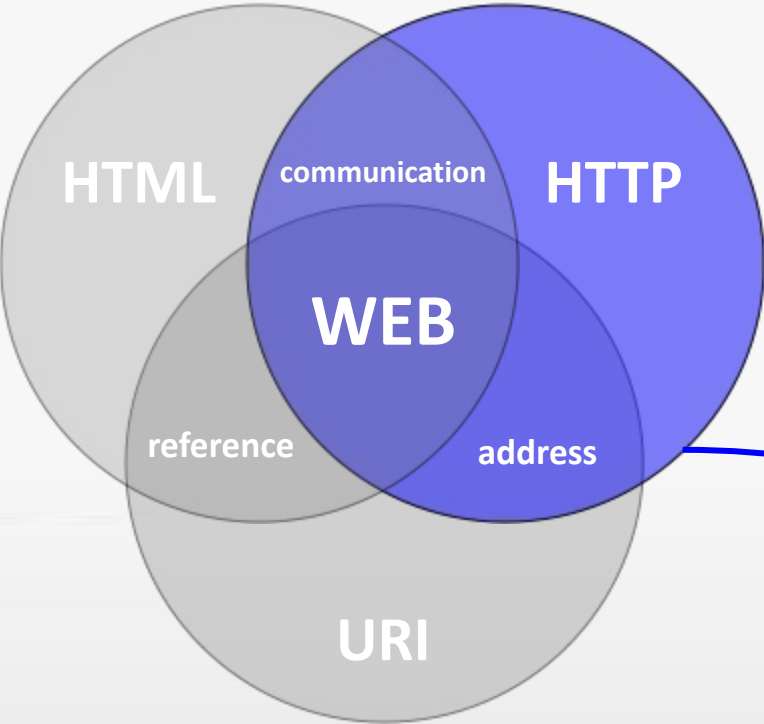
- I want to have **information** about an apple from Wikidata.

```
curl -L -H "Accept: text/html" https://www.wikidata.org/entity/Q89
```

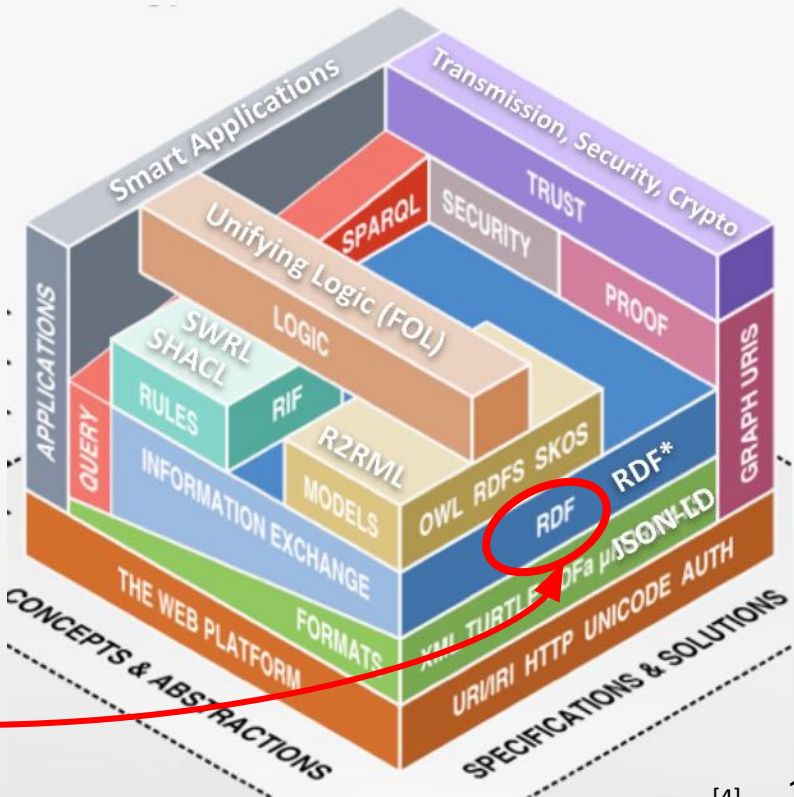
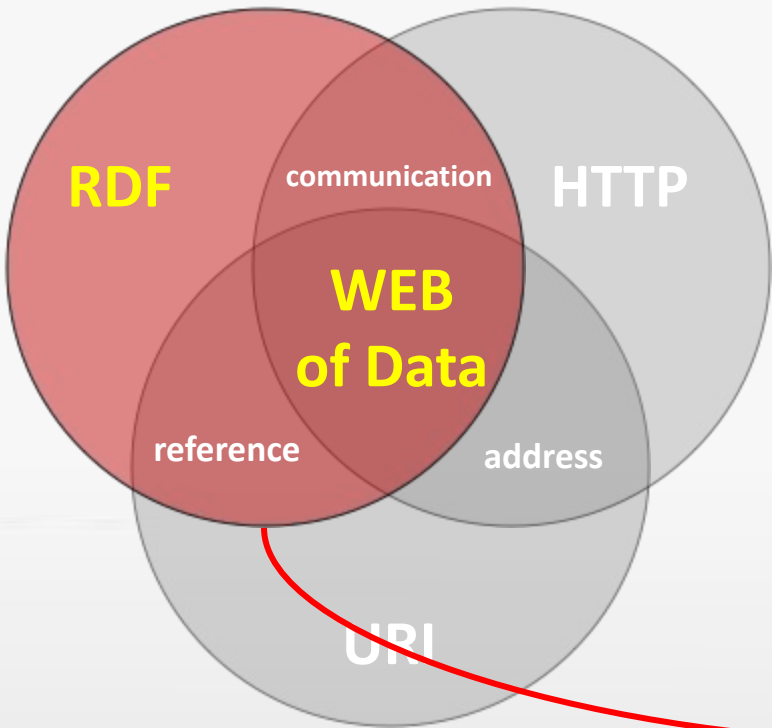
- I want to have **machine readable information** about an apple from Wikidata.

```
curl -L -H "Accept: text/turtle" https://www.wikidata.org/entity/Q89
```

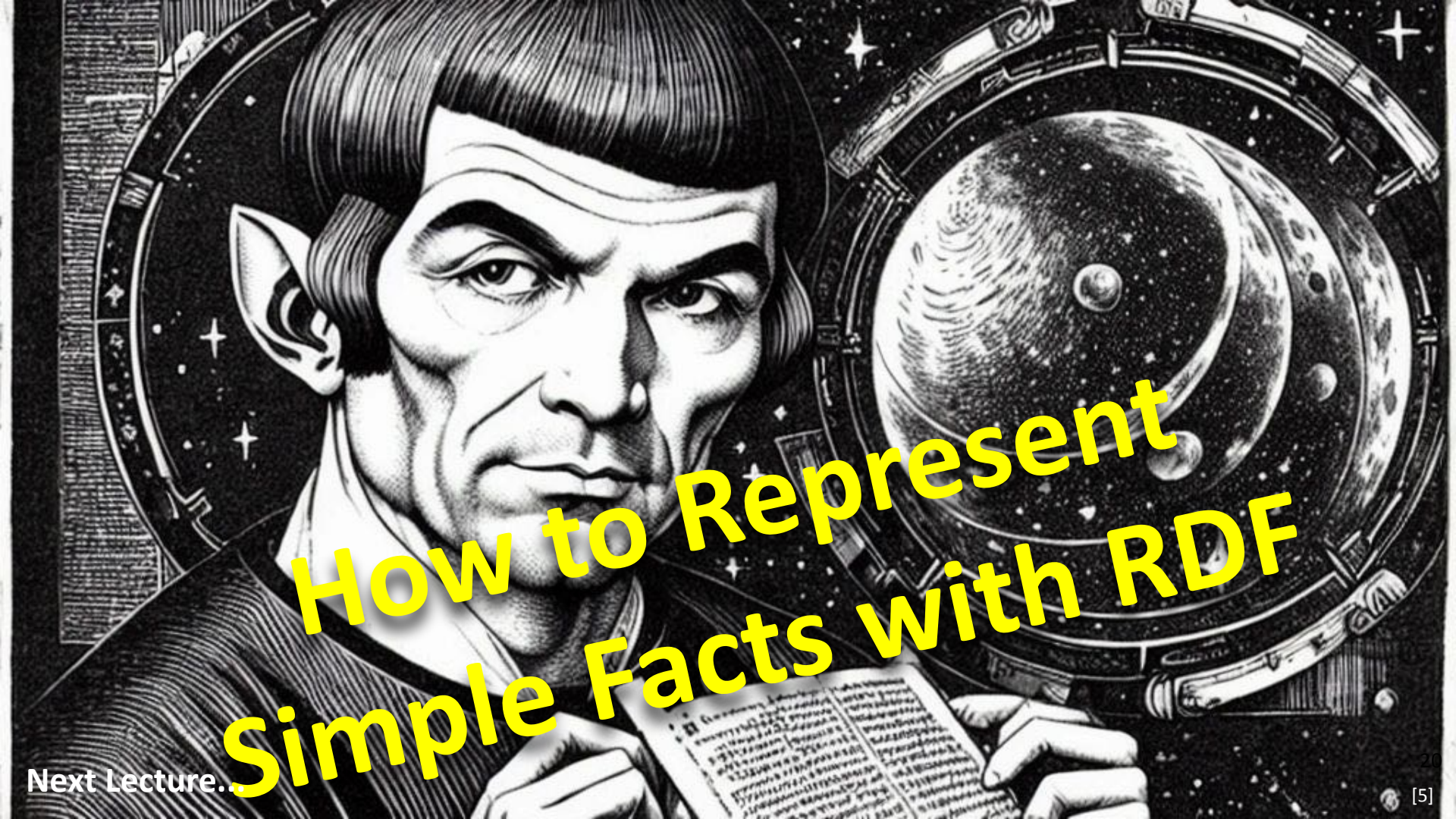
# Basic Architecture of the Web of Data



# Basic Architecture of the Web of Data







# How to Represent Simple Facts with RDF

Next Lecture...



### Bibliographic References:

- Ogden, Charles Kay, & Richards, Ivor Armstrong (1923). [\*The Meaning of Meaning: A Study of the Influence of Language upon Thought and of the Science of Symbolism\*](#), K. Paul, Trench, Trubner & co., Ltd, Harcourt, Brace & company, inc.
- Leo Sauermann, Richard Cyganiak (2008), [\*Cool URIs for the Semantic Web\*](#), W3C Interest Group Note 03 December 2008.

### Picture References:

- [1] “The Resource Description Framework (RDF) is a W3C standard originally designed as a data model for metadata...”, created via ArtBot, Anything Diffusion - generic scifi, 2023, [CC-BY-4.0], <https://tinybots.net/artbot>
- [2] Johannes Osterhoff (2010), *Ceci n'est pas une pomme*, in Harald Sack, *Semantic Web Technologien*, HPI lecture 2010/11, [CC-BY-4.0]
- [3] Phone Conversation Indicating Chit Chat And Discussion, [CC0], <https://www.piqsels.com/en/public-domain-photo-iradox>
- [4] Benjamin Nowack, *The Semantic Web - Not a Piece of cake...*, at bnode.org, 2009-07-08, [CC BY 3.0], <https://web.archive.org/web/20220628120341/http://bnode.org/blog/2009/07/08/the-semantic-web-not-a-piece-of-cake>
- [5] “In this image in the style of Dürer's Renaissance woodcuts, Mr. Spock, science officer of the USS Enterprise, is depicted in deep space fully covered with interlinked the RDF source code fragments.”, created via ArtBot, Protogen Diffusion 2023, [CC-BY-4.0], <https://tinybots.net/artbot>