

Knowledge Graphs

Lecture 1 - Knowledge Graphs in the Web of Data

1.6 Linked Data and the Web of Data

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KIT
Karlsruher Institut für Technologie



FIZ Karlsruhe
Leibniz-Institut für Informationsinfrastruktur

Knowledge Graphs

Lecture 1: Knowledge Graphs in the Web of Data

1.1 Data, Information, and Knowledge

1.2 How to Represent Knowledge?

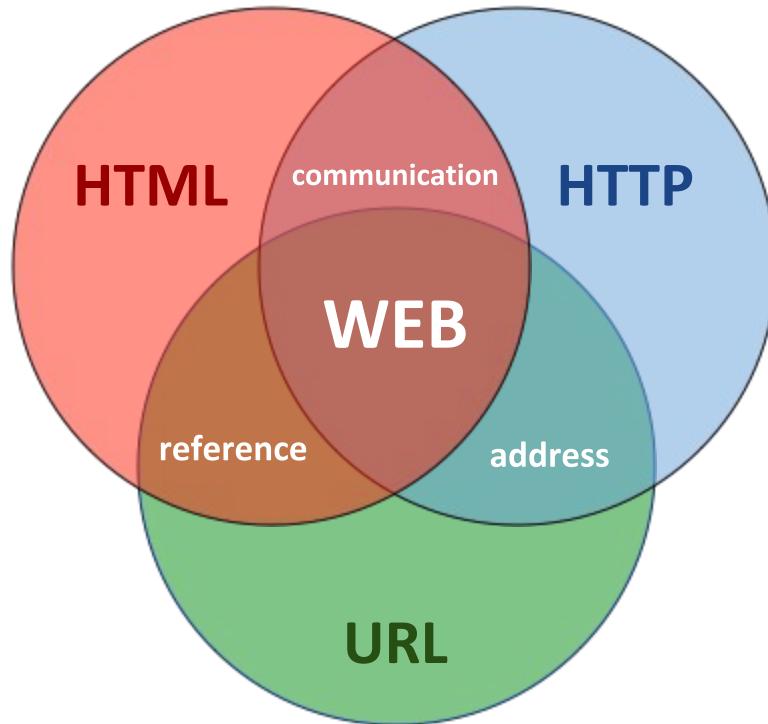
1.3 The Art of Understanding

1.4 Towards a Universal Knowledge Representation

1.5 The Semantic Web

1.6 Linked Data and the Web of Data

The Basic Architecture of the Web



1. Identification (URI) & address (URL)
e.g. `http://fiz-karlsruhe.de`

2. Communication / protocol (HTTP)
`GET /index HTTP/2`
`Host: fiz-karlsruhe.de`

3. Representation language (HTML)
`Mehwish works at`
``
`FIZ.`

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

Most apps use only a subset of the stack

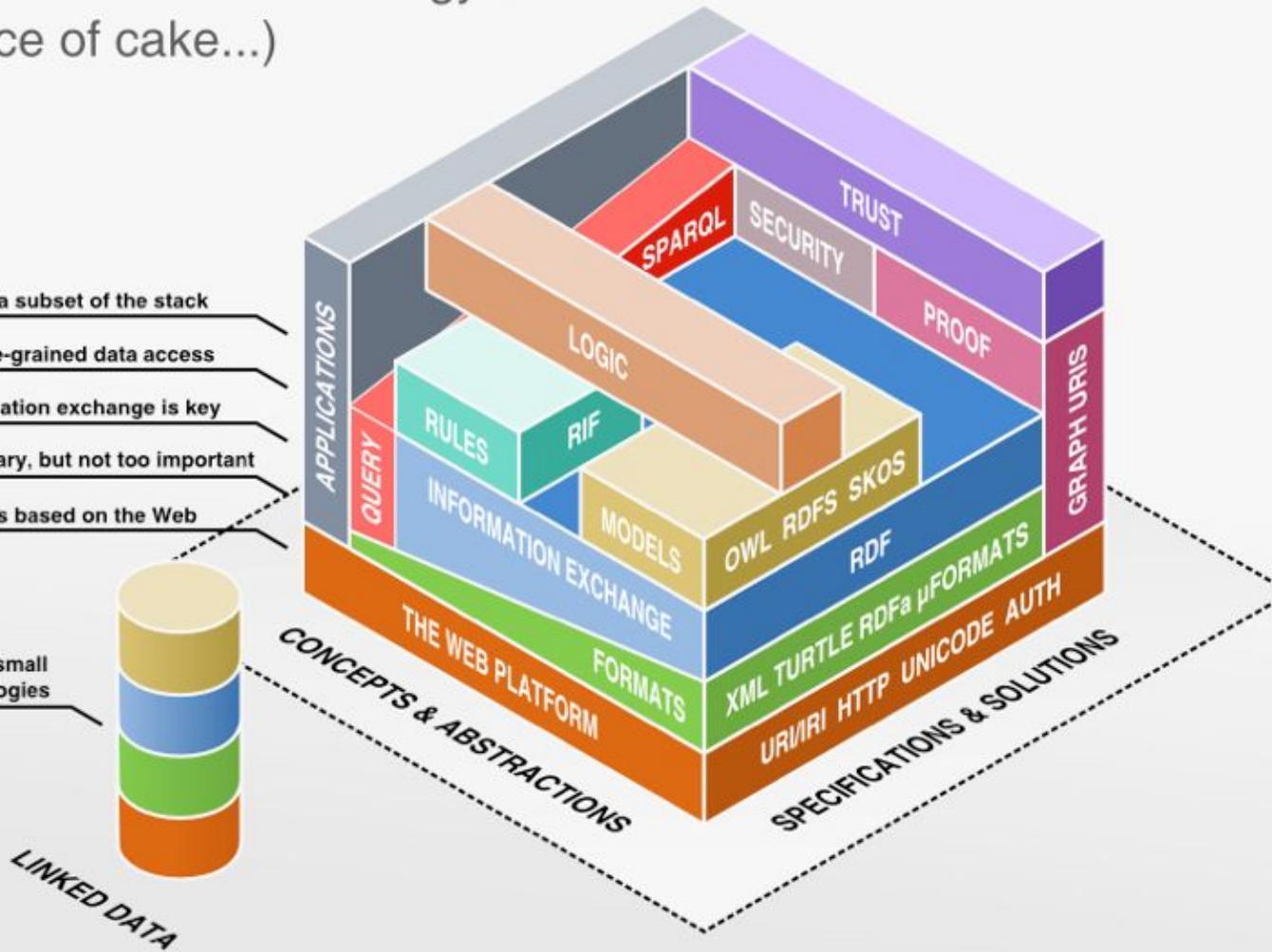
Querying allows fine-grained data access

Standardized information exchange is key

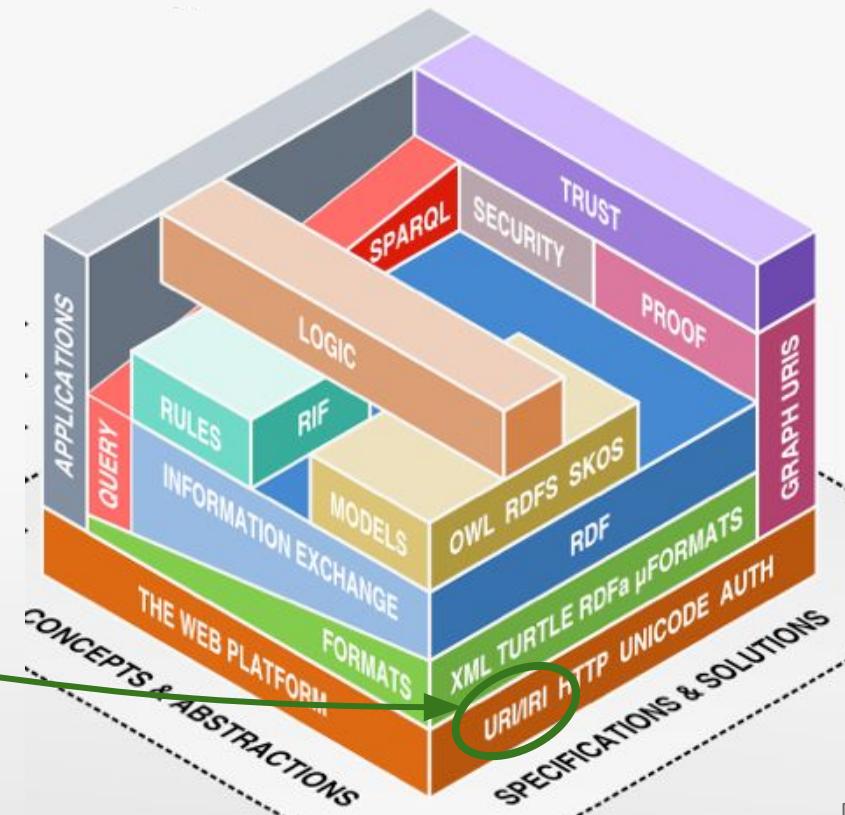
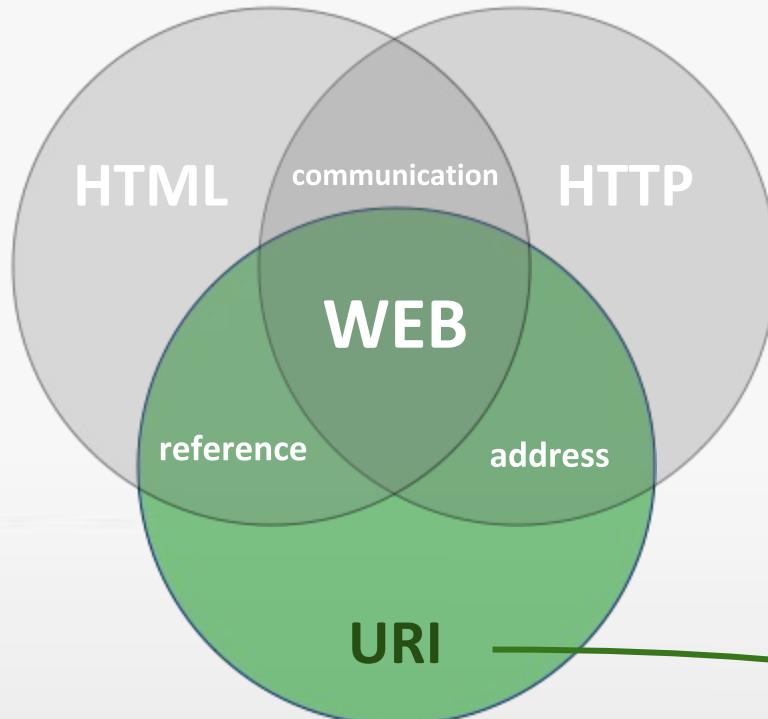
Formats are necessary, but not too important

The Semantic Web is based on the Web

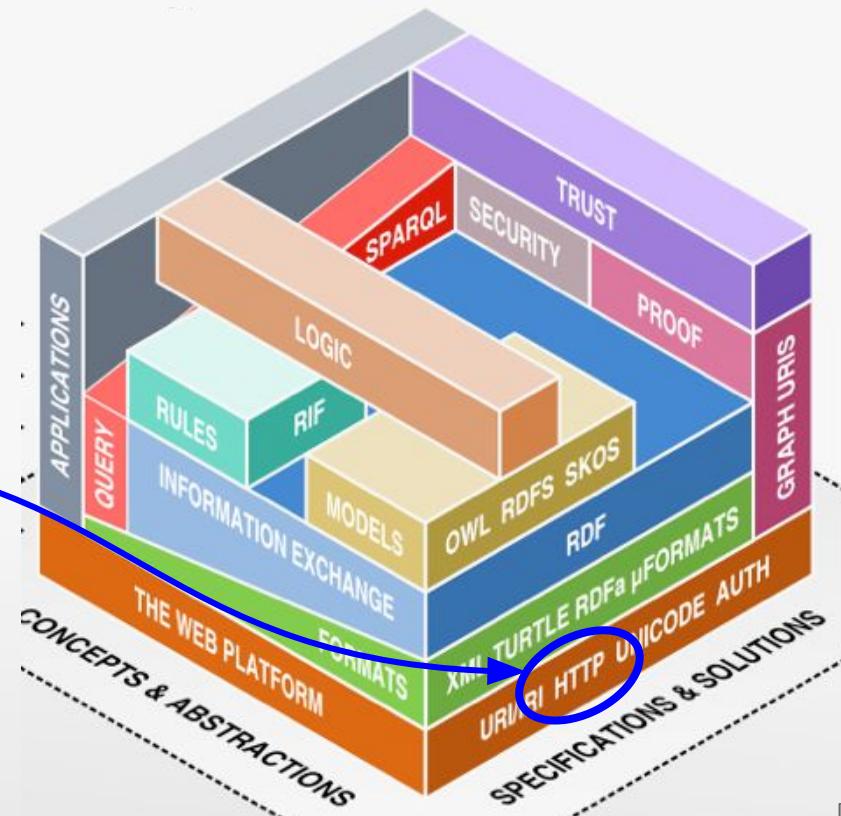
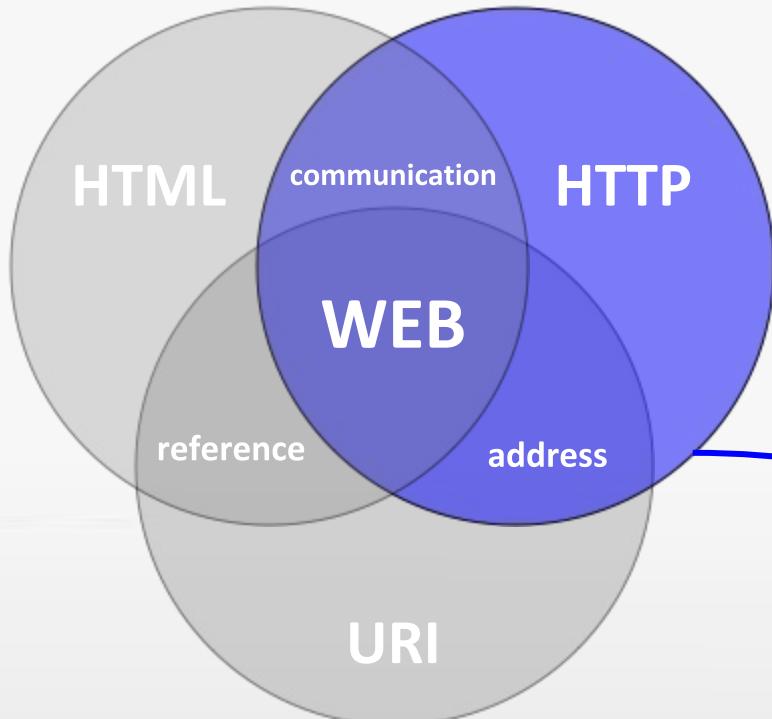
Linked Data uses a small selection of technologies



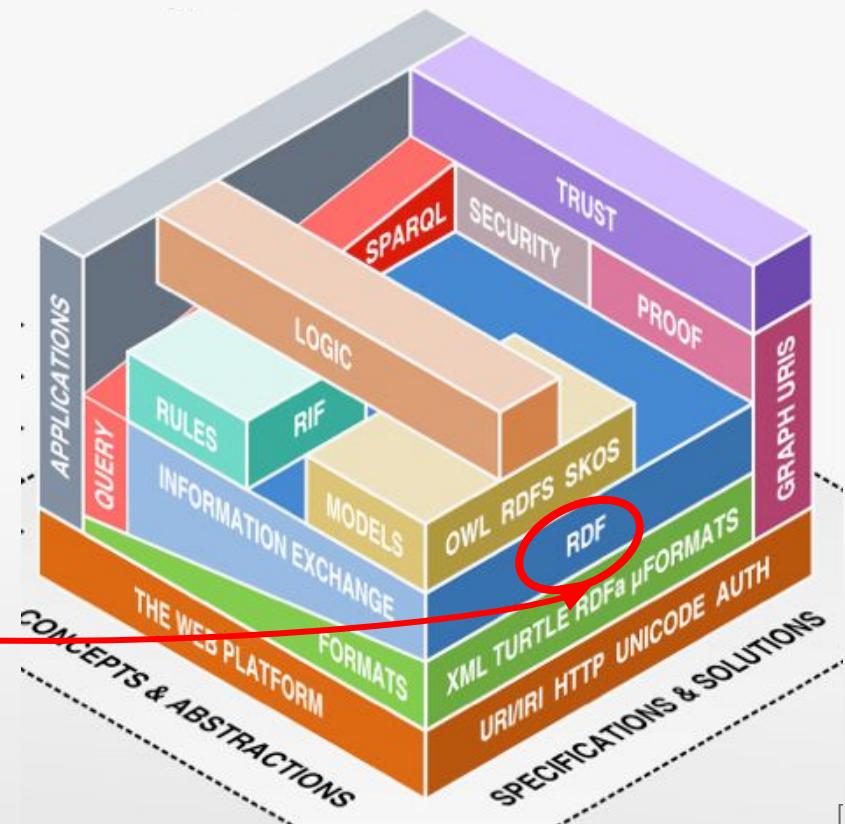
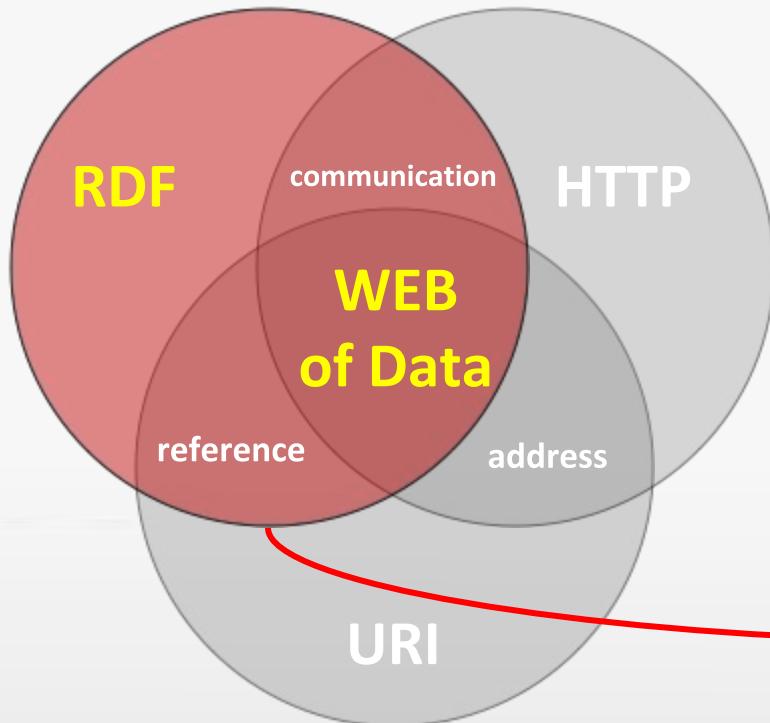
Basic Architecture for the Web of Data



Basic Architecture for the Web of Data



Basic Architecture for the Web of Data



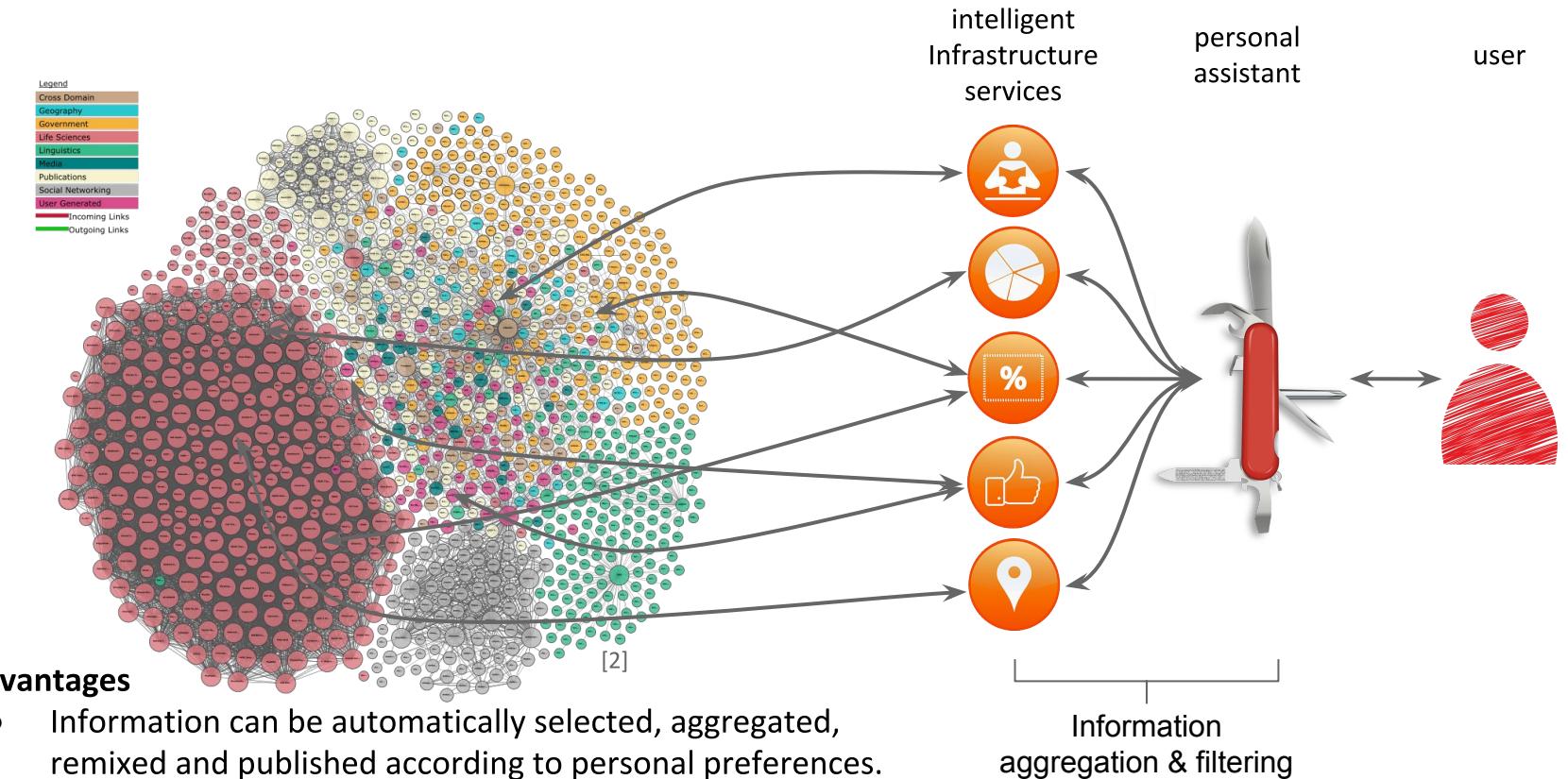
The Semantic Web - A Web of Data

- The **Web of Data** is an upgrade of the traditional Web of Documents.
- It is the Web as a huge decentralised database (knowledge base) of **machine-accessible data**.

„The web of **human-readable document** is being merged with a web of **machine understandable data**. The potential of the mixture of humans and machines working together and communication through the web could be immense.“

Tim Berners-Lee, [The World Wide Web: A very short personal history](#), May 1998

How to Access the Web of Data?



The Web of Data

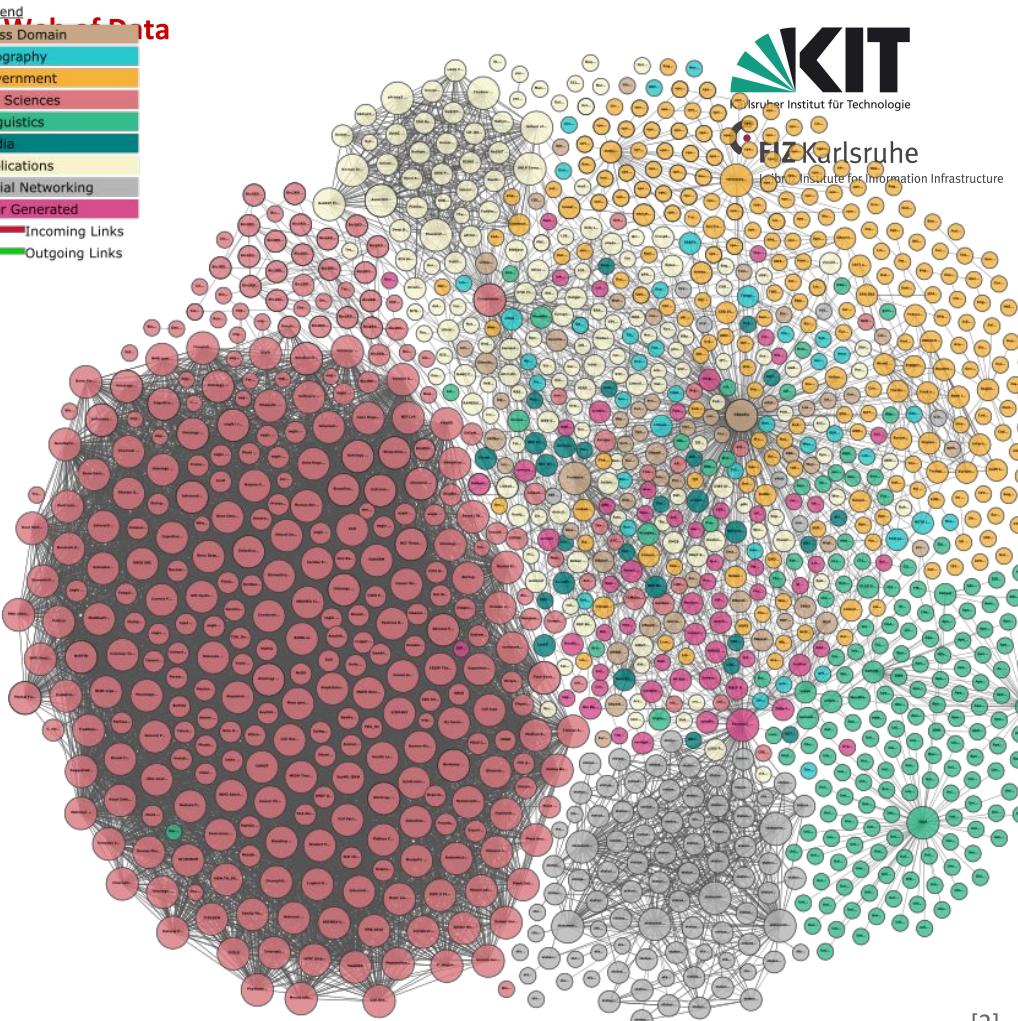
Linked Data

- Linked Open Data (LOD) denote publicly available (RDF) Data in the Web, identified via URI and accessible via HTTP. Linked data link to other data via URI.

The Web of Data

- 9,960 datasets
 - >149 billion facts
 - >800 million links
- (April 2017)

<http://lod-cloud.net/>



Born 21 March 1685. Died 26 July 1750.



BBC PROMS

Nigel Kennedy And His Band Play Bach

At the late night Prom, Nigel Kennedy and his band play arrangements of pieces by Bach.

JOHANN SEBASTIAN BACH 54 OF 15



Biography

Born in the German town of Eisenach, J. S. Bach was a chorister then violinist before taking his first organist post at Arnstadt while still a teenager. It was in Weimar, as court organist from 1708, that Bach began to produce monthly cantatas, and wrote many of his great organ works, as well as organ transcriptions of concertos by Vivaldi.

In 1717 Prince Leopold offered him the position of Kapellmeister at Cöthen, where he wrote the Brandenburg Concertos, the four Orchestral Suites and the violin concertos, and married his second wife Anna Magdalena, who bore 13 children. Bach's financial duties in his final job, as Kantor of the Thomasschule in Leipzig from 1723 until his death, involved teaching Latin and Music, choir-training, and writing and directing music for the services.

Nevertheless he managed also to write the Mass in B minor, the six choral Motets, The Art of Fugue, The Musical Offering and Goldberg Variations during this time. His inventive contrapuntalism became unfashionable soon after his death until the early 19th century, since when his reputation has remained unquestioned.

Profile © Edward Bhosaria

Links & Information

LINKS
Biography at jbach.org and pbs.org/wgbh/education/bach.html

Wikipedia article on Johann Sebastian Bach

IMDb at imdb.com/title/tt0001925

Last.fm page on Johann Sebastian Bach

Discogs at discogs.com/artist/Johann+Sebastian+Bach

MusicBrainz entry on Johann Sebastian Bach

PERSONAL RELATIONSHIPS

Parent of Johann Christian Friedrich Bach, Johann Christian Bach, Wilhelm Friedemann Bach and Carl Philipp Emanuel Bach

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Keyboard Concertos (piano): Alexandre Tharaud

- Concerto for keyboard and orchestra BWV1054 in D minor - I Allegro
- Concerto for keyboard and orchestra BWV1054 in D minor - II Adagio

Played By

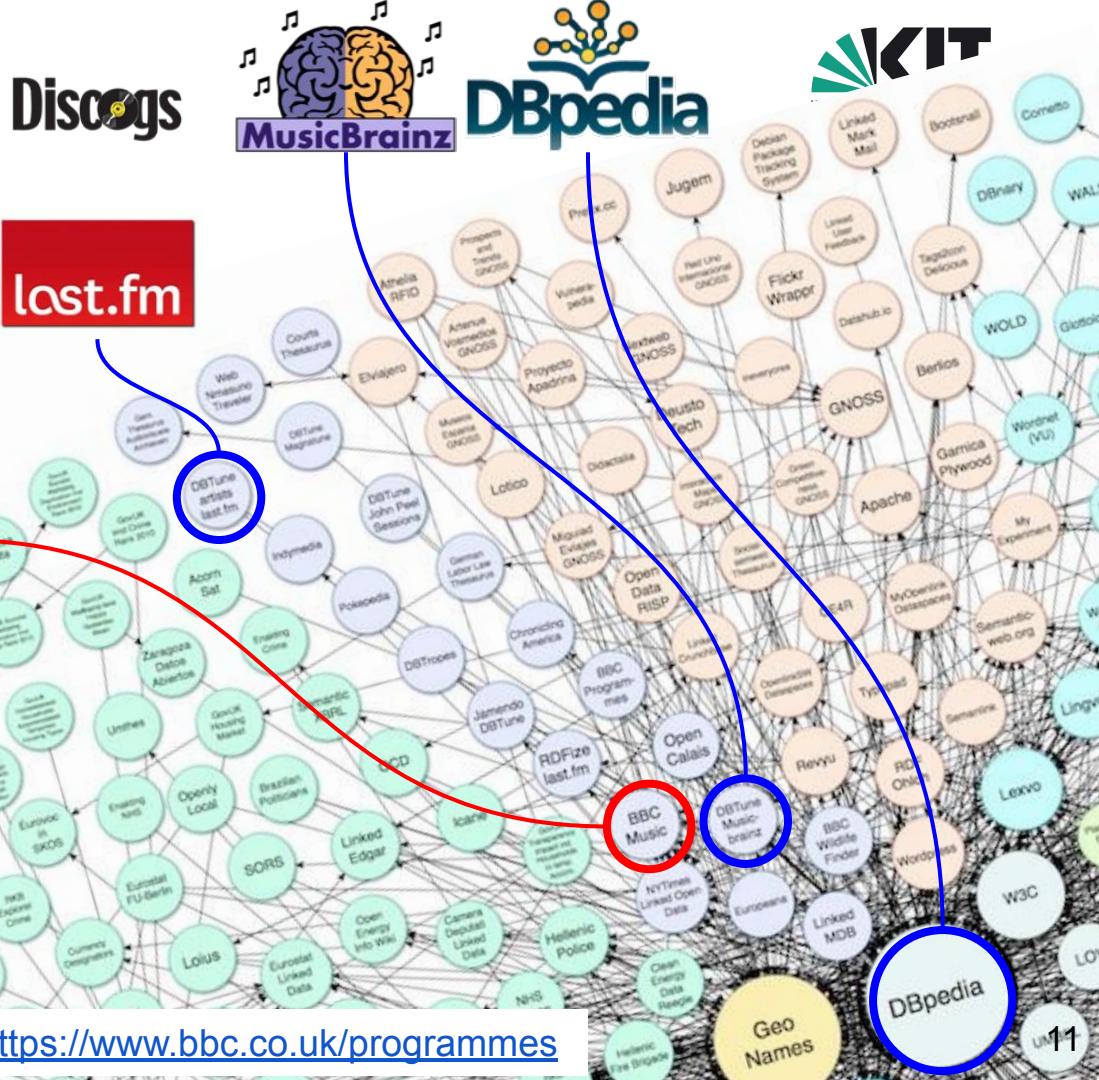
Since December 2008

Breakfast BBC Radio 3

Desert Island Discs BBC Radio 4

In Tune BBC Radio 3

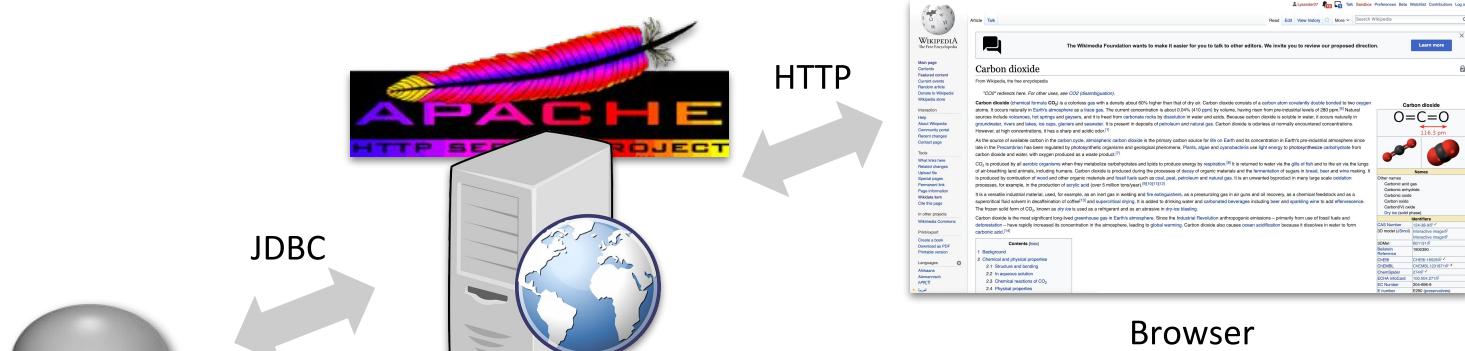
The Early Music Show BBC Radio 3



<https://www.bbc.co.uk/programmes>

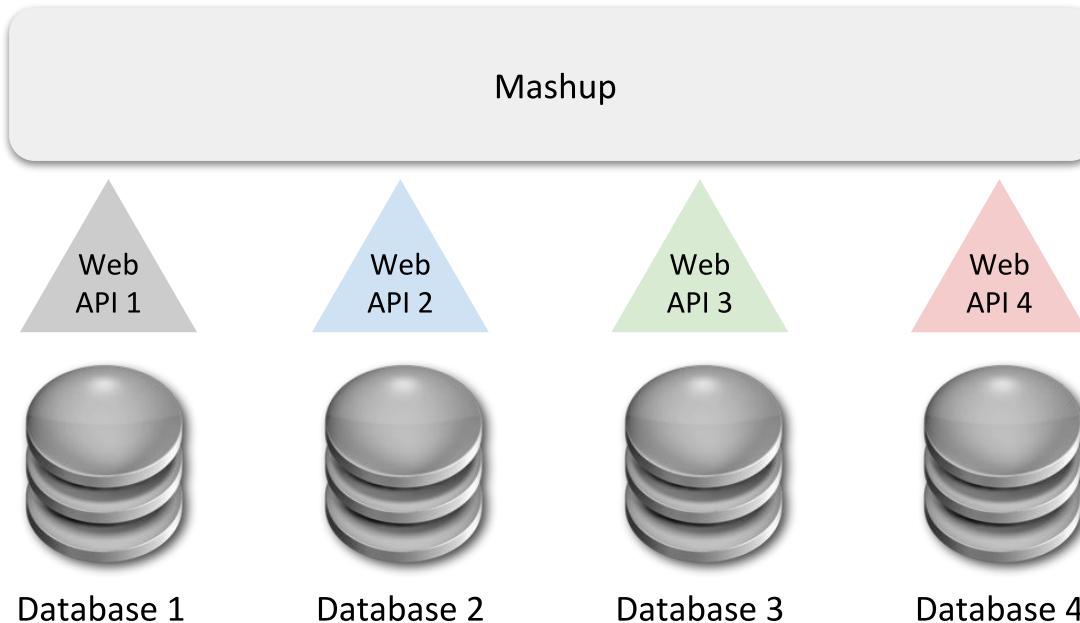
Data Access in the traditional Web

- Data can only be found on the Web, if it is available at some website.



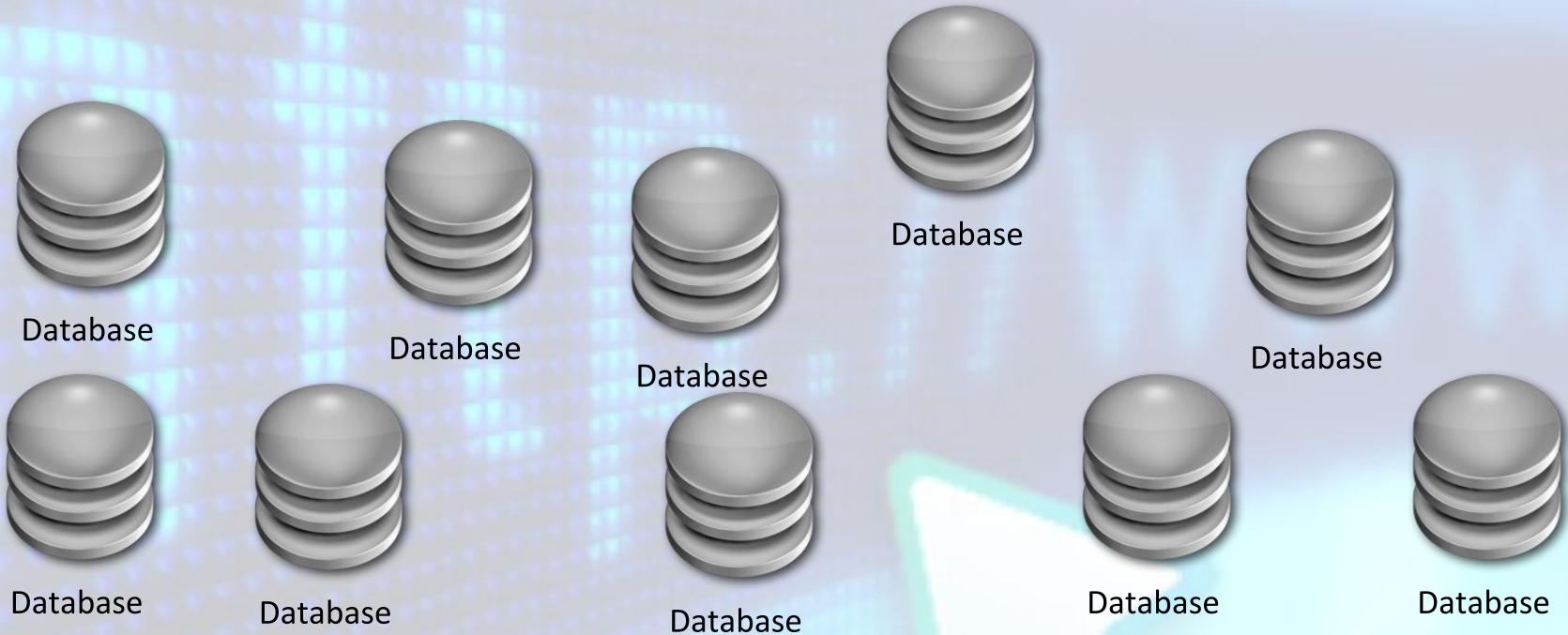
Data Access in the traditional Web

- There is a number of different (proprietary) **Web APIs**, data exchange formats, and **Mashups** on top of that.



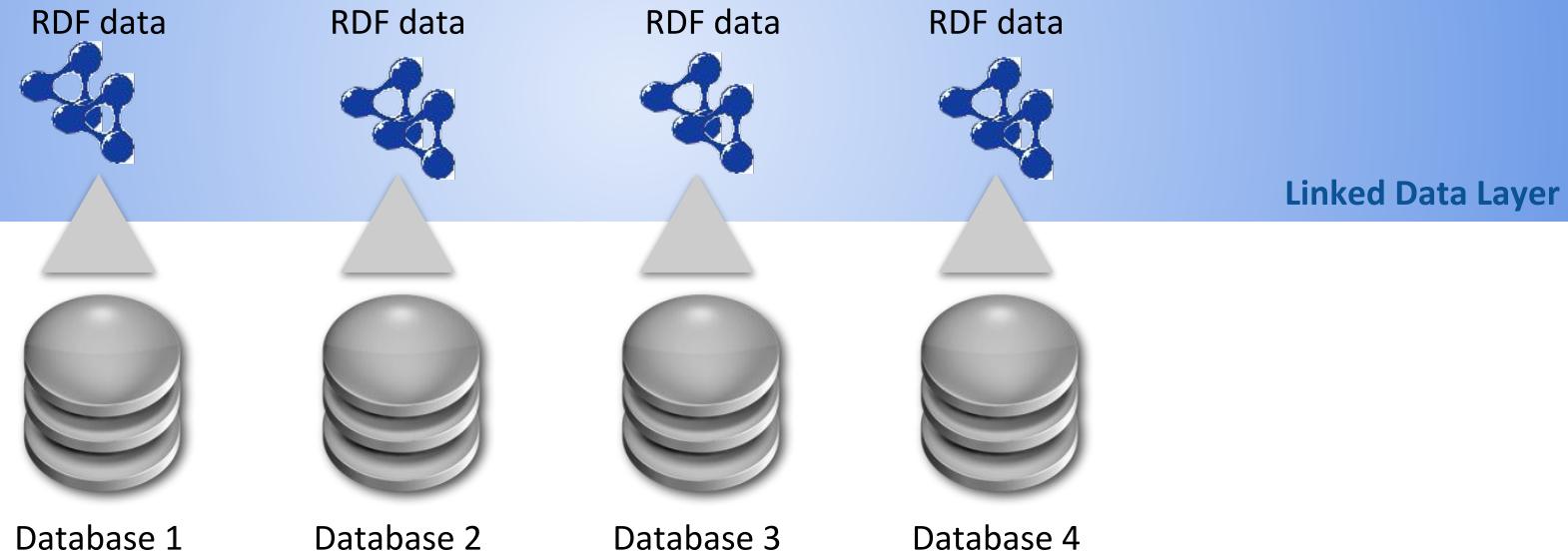
In the traditional Web...

- Data is locked up in **small data islands**.
- Other applications usually cannot access this data...



How to get rid of Closed Data Island?

- **Apply Linked Data technology**
 - to publish (structured) data on the Web
 - to draw connections from one data source to data from other data sources



Linked Data Principles

1. Use **URIs** as names for things.
2. Use **HTTP URIs**, so that people can **look up** those names.
3. When someone looks up a URI, provide **useful information**, using the **standards** (RDF, SPARQL).
4. Include **links to other URIs**, so that they can discover more things.

Born in the German town of Eisenach, J. S. Bach was a chorister then violinist before taking his first organist post at Arnstadt while still a teenager. It was in Weimar, as court organist from 1708 to 1717, that Bach married Anna Magdalena Wilhelmine, his first wife, and began his career as a professional composer.

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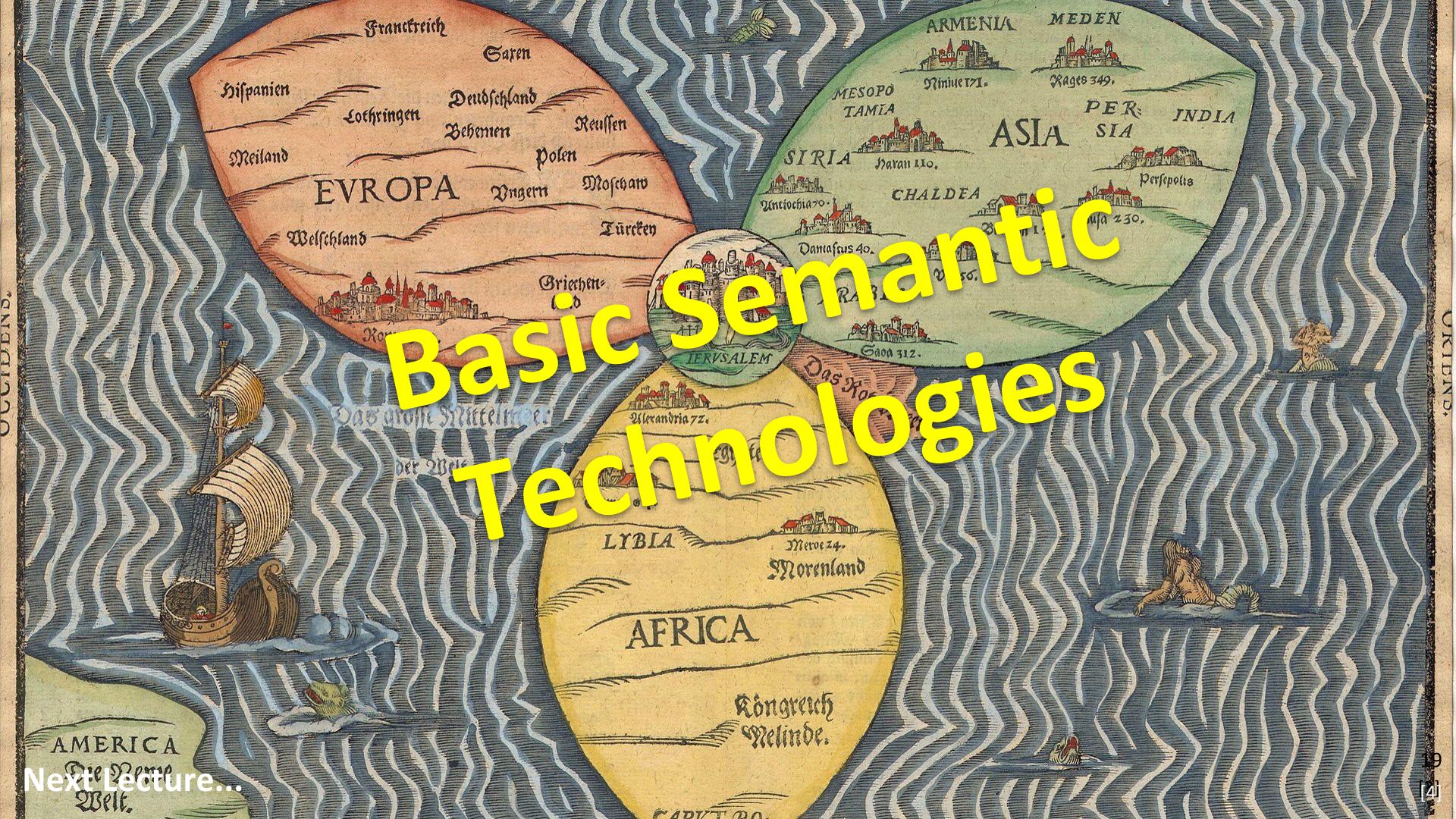
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Linked Open Data

- Public Linked Data resources on the Web, licensed as Creative Common CC-BY
- Tim Berners-Lee's 5-Star Criteria for Linked Open Data
 - ★ Available on the Web (whatever format) but with an **open licence**, to be Open Data
 - ★★ Available as **machine-readable structured data**
(e.g. excel instead of image scan of a table)
 - ★★★ as (2) plus **non-proprietary format** (e.g. CSV instead of excel)
 - ★★★★ All the above plus: use **open standards from W3C**
(RDF and SPARQL) to identify things, so that people can point at your stuff
 - ★★★★★ All the above, plus: **link your data to other people's data** to provide context

Basic Semantic Technologies



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] The Linked Open Data Cloud, <https://lod-cloud.net/>
- [3] The fifth plague of Egypt, cattle dying. The Wellcome Collection, [CC-BY-4.0]
<https://wellcomecollection.org/works/m8g9bptf>
- [4] Heinrich Bünting, Stylized world map in the shape of a clover-leaf (the three classical continents of Europe, Asia, Africa), with Jerusalem at the center, with additional indication of Great Britain, Scandinavia and America / the New World.
Page 4f. of Die eigentliche und warhaftige gestalt der Erden und des Meers (1581), printed in Magdeburg.
https://commons.wikimedia.org/wiki/File:1581_Bunting_clover_leaf_map.jpg