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Semantic Web and Linked Data

M.EIC FEUP

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S1 2025/26

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Class 1: Learning Objectives

- Know the Professor and the Colleagues;
- Understand the syllabus and the design of the course.

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Teaching Staff

- Liliana Ferreira (lsferreira@fe.up.pt)
  - Office Hours: after class and by appointment

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Semantic Web and Linked Data

- The syllabus of Semantic Web and Linked Data has a strong emphasis on **representation and querying languages** and their underlying principles, namely logic and inference.

- These languages and principles provide a body of knowledge that ranges from the concepts of Semantic Web and Linked Data to their application in describing web resources and in explicit and interoperable representations for data in multiple domains.

Objectives

1. Describe and define the concepts and technologies associated with the Semantic Web;
2. Analyze and prepare artifacts (e.g., ontologies) for use in Semantic Web solutions;
3. Evaluate the value and applicability of semantic web strategies in various contexts;
4. Identify and apply multiple Semantic Web-related tools and techniques;
5. Analyze the characteristics of data and documents accessible to people and machines;
6. Relate web resources to the metadata that describe and link them;
7. Treat ontologies as providers of description tools;
8. Analyze existing ontologies and create new ontologies;
9. Explore applications that manipulate semantic web information descriptions and develop systematic methods for creating metadata;
10. Experiment with applications that explore Linked Open Data on the Web;
11. Use tools and languages to explore Semantic Web content;
12. Compare semantic web-based services and other approaches to resource description.

Bibliography

- Several provided during the course;
- Antoniou, G., Groth, P., van Harmelen, F., & Hoekstra, R. (2012). A Semantic Web Primer. MIT Press; 3rd edition.
- Heath, T., Bizer, C. (2011). Linked Data: Evolving the Web into a Global Data Space (1st edition). Synthesis Lectures on the Semantic Web: Theory and Technology, 1:1, 1-136. Morgan & Claypool.
- International Semantic Web Conference (ISWC), http://iswc.semanticweb.org/
- Journal of Web Semantics, Elsevier, http://www.elsevier.com/wps/find/journaldescription.cws_home/671322/description

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Teaching Methodology

- The theoretical components of classes are used for topic presentation, with reference to the bibliography, and for running small assignments to stimulate learning.
- The time dedicated to practical work is used to discuss topics proposed to students, to answer practical exercises on the Semantic Web and to develop the practical work.
- The students will apply the theoretical concepts in a small project in an area of interest.

- Evaluation: distributed assessment with final exam

Final Rating = 60% * GradeWork + 40% * GradeExam

Calendar

Available in Moodle:

https://moodle2526.up.pt/pluginfile.php/138469/mod_resource/content/1/Planeamento_WSDL2526.pdf

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Class 1: Learning Objectives

Know the Professor and the colleagues;

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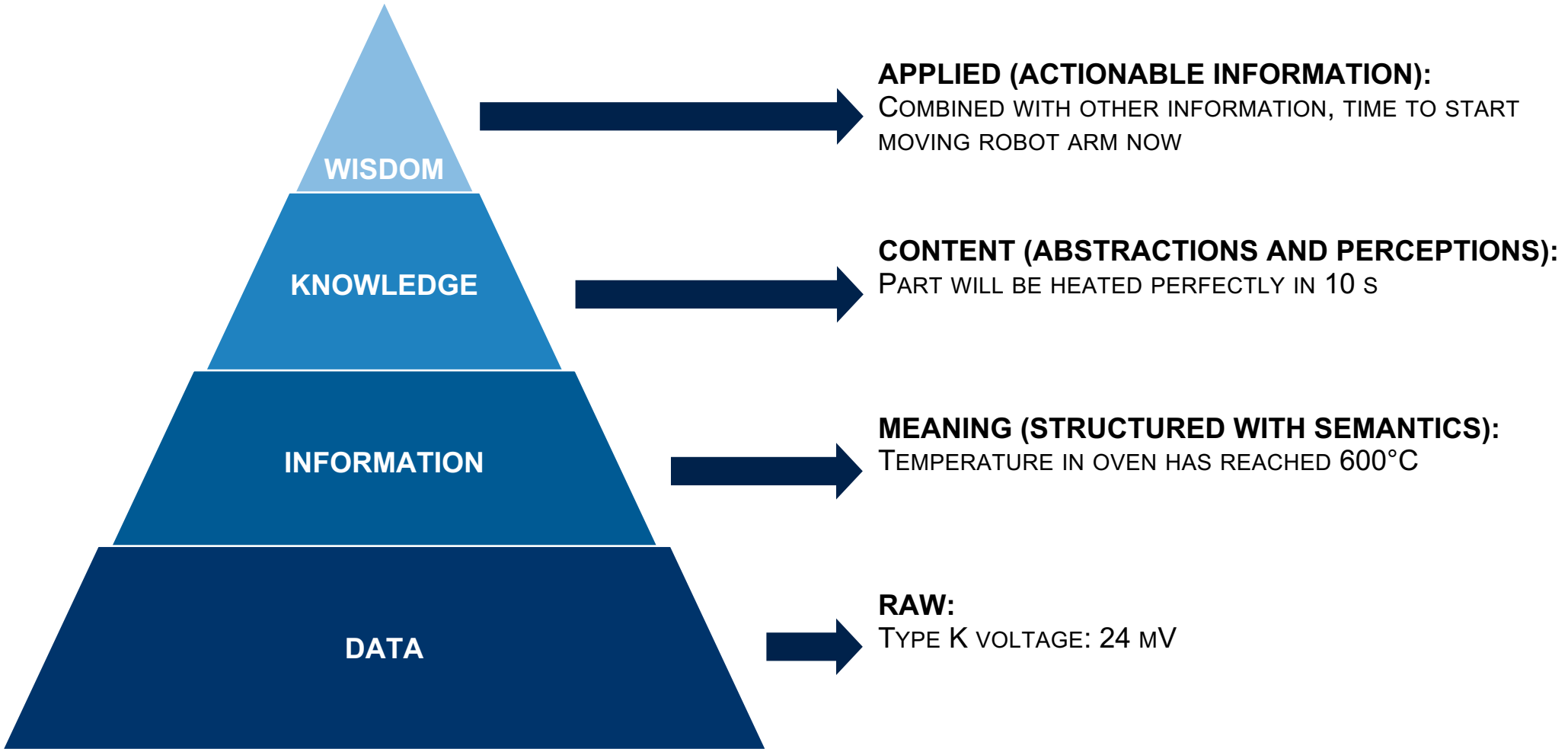
Data, Information, Knowledge



Source: adapted from “Machine learning powers autonomous industrial systems”. October 2017. Texas Instruments.

Just for fun!

Knowledge is knowing that tomato is a fruit.

Wisdom is knowing not to put it in a fruit salad.

Philosophy is wondering whether that makes ketchup a smoothie.

Common sense is knowing that ketchup isn't a smoothie.

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Data, Information, Knowledge

Internet vs Web

This photo, taken by the W3C during the 25th anniversary of the Web, shows Tim Berners-Lee (left) and Vinton Cerf (right) wearing t-shirts made for the occasion to remind that they are the inventors of two very different things: the **Internet** for Vinton Cerf and the **Web** for Tim Berners-Lee.

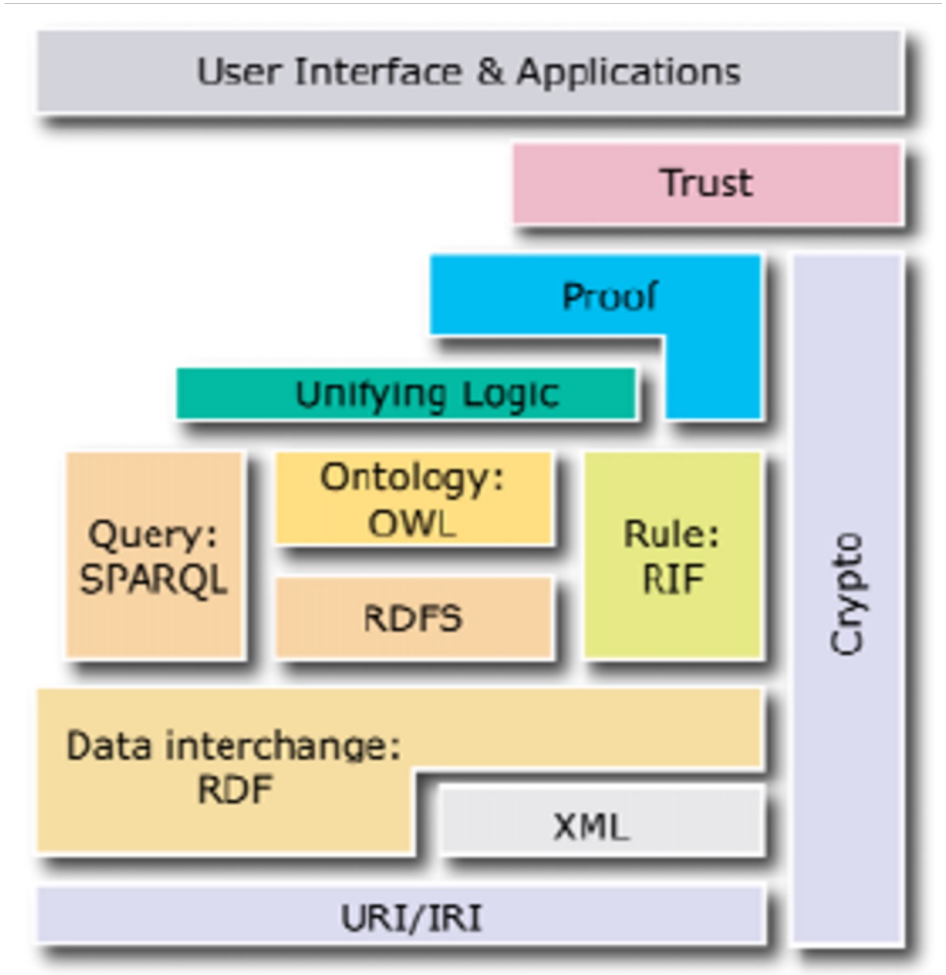
We connect our computers to the Internet and we surf the Web.

The Semantic Web

"The **Semantic Web** is an extension of the current web in which information is given well-defined **meaning,** better enabling computers and people to **work in co-operation**."

[Berners-Lee *et al*, 2001]

Linked Open Data Principles



The Semantic Web Layer Cake

The many names of the Semantic Web

One difficulty, the first time you discover linked data on the Web, is that the initiative is presented under different names, each name insisting on a different facet of the overall architecture:

- The name “**Web of data**” insists on the opportunity now offered to us on the Web to open silos of data of all sizes, from the dataset of an address book up to immense genomic databases, and to exchange, to connect, to mix them on the Web according to our needs.
- The name "**linked open data**" focuses on the opportunity to exploit open data from the Web in our applications and the high added value there is in using and reusing URIs to join assertions from different sources. This name also reminds us that linked data are not necessarily open and that all the techniques we are introducing here can be used in private spaces (intranets, intrawebs, extranets, etc.)
- The name "**giant global graph**" puts into perspective the thousands of links between data distributed on the Web and which, joined through URIs, produce a giant graph.
- The name “**semantic web**” emphasizes the ability we now have to exchange our data schemas, in addition to datasets, and the associated semantics in order to enrich the range of automatic processing that can be performed on them.
- But in fact, these names are just different facets of one global initiative.

...and remember “applications pass but data remain”

Documents about the World Wide Web Consorsium (W3C)

"The World Wide Web Consortium (W3C) is an international community where Member organizations, a full-time staff, and the public work together to develop Web standards." About W3C.

The standards we will use in this Course have been created inside the W3C.

Here are some documents presenting different aspects of W3C:

•Mission of the consortium: http://www.w3.org/Consortium/mission

•Organization of the consortium: http://www.w3.org/Consortium/facts

•Processes of the consortium: http://www.w3.org/Consortium/Process/

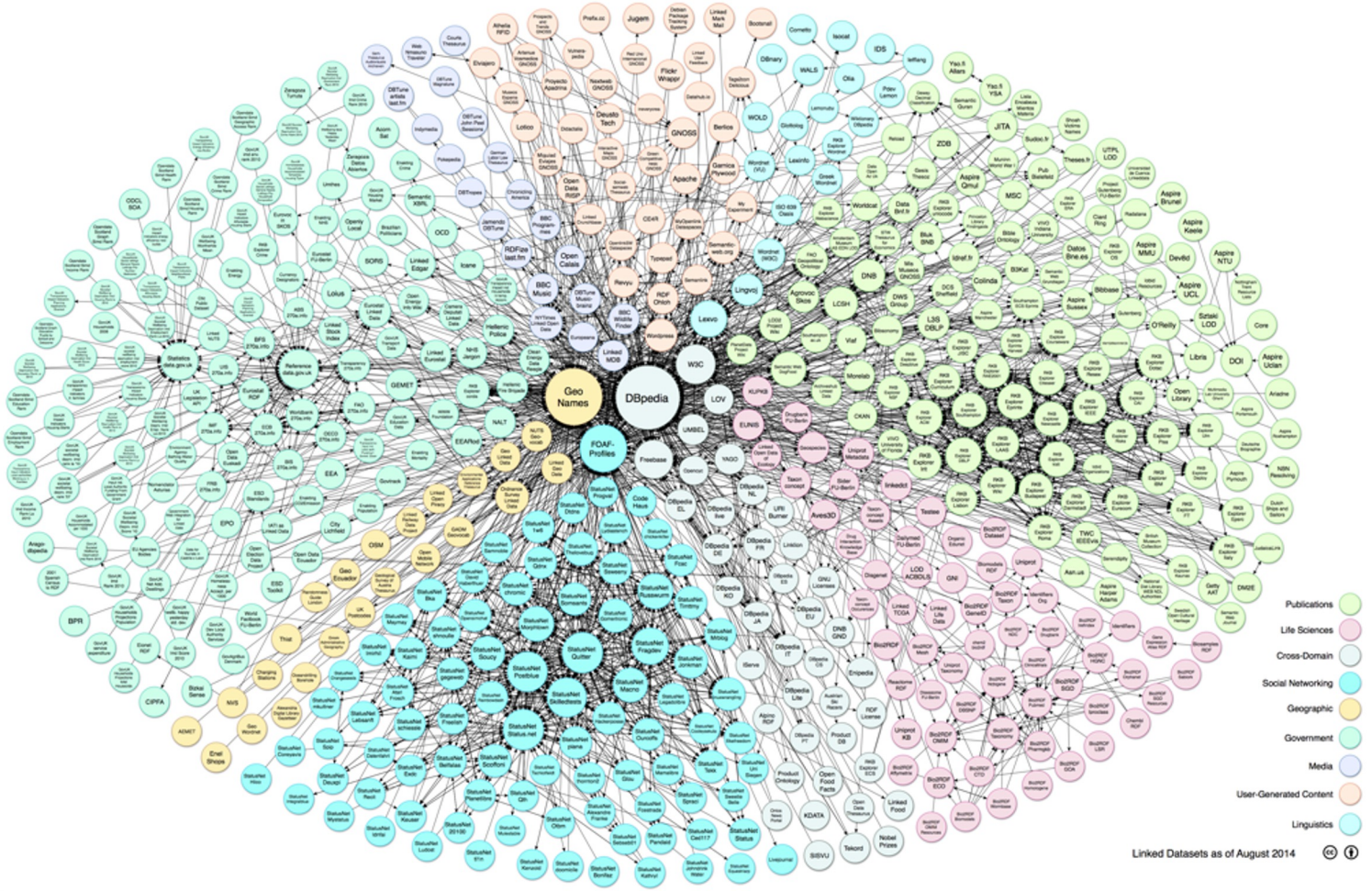
•Code of Ethics and Professional Conduct of the consortium: http://www.w3.org/Consortium/cepc/

•Positive Work Environment code of consortium: http://www.w3.org/Consortium/pwe/

And you can follow the news on the website of W3C and receive a weekly newsletter by sending an email with the subject "Subscribe" to w3c-announce-request@w3.org.

See also: https://www.w3.org/blog/news/

The Web site "Linking Open Data cloud diagram" provides an overview of the linked open data cloud on the Web.



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Kurzgesagt – In a Nutshell

Linked Data is about the use of URIs as names for things, the ability to dereference these URIs to get further information and to include links to other data.

Further reading

- Semantic Web: Past, Present, and Future: A Scherp, G Groener, P Škoda, K Hose, ME Vidal. Dec 2024.

- A Survey of the First 20 Years of Research on Semantic Web and Linked Data
- Semantic Web Activity, W3C
- Data Activity, W3C
- Semantic Web Road Map, An attempt to give a high-level plan of the architecture of the Semantic WWW, Tim Berners-Lee, 1998