Outline

- What is required to understand the content on the Web?
- How web evolution has taken place?
- What are expectation from the Web?

Prelude

- Johannes Gutenberg developed a **movable type printing** in 1447.
  - primary goal was to develop a mechanism to speed the printing
  - Result
    - books, journals, newspapers, scientific papers, etc….

- Tim Berners-Lee (with colleagues) created the **World Wide Web** in 1989.
  - independent contractor at CERN in Geneva (European Organization for Nuclear Research).
  - primary goal was to provide rapid, electronic access to the online technical reports and other documents created by the world's high-energy physics laboratories.
  - Result
    - fundamental change of human communication and social interaction.

The Web

- Collection of interlinked hypertext documents accessible using internet.
- The Web
  - HTTP (how to transfer data) ….. GET/index.html
  - URI (how to address data) ….. http://www.uclab.khu.ac.kr/
  - HTML (to mark up data for human reader) .. <html><head><title>.....

- Immensely successful.
- Huge amounts of data.
- Syntax standards for transfer of structured data.
- Human-readable documents.

Web Vision

- Billions of diverse resources/documents online

Retrieving documents

Extracting relevant data from retrieved documents

Combining information from different sources to achieve a particular goal

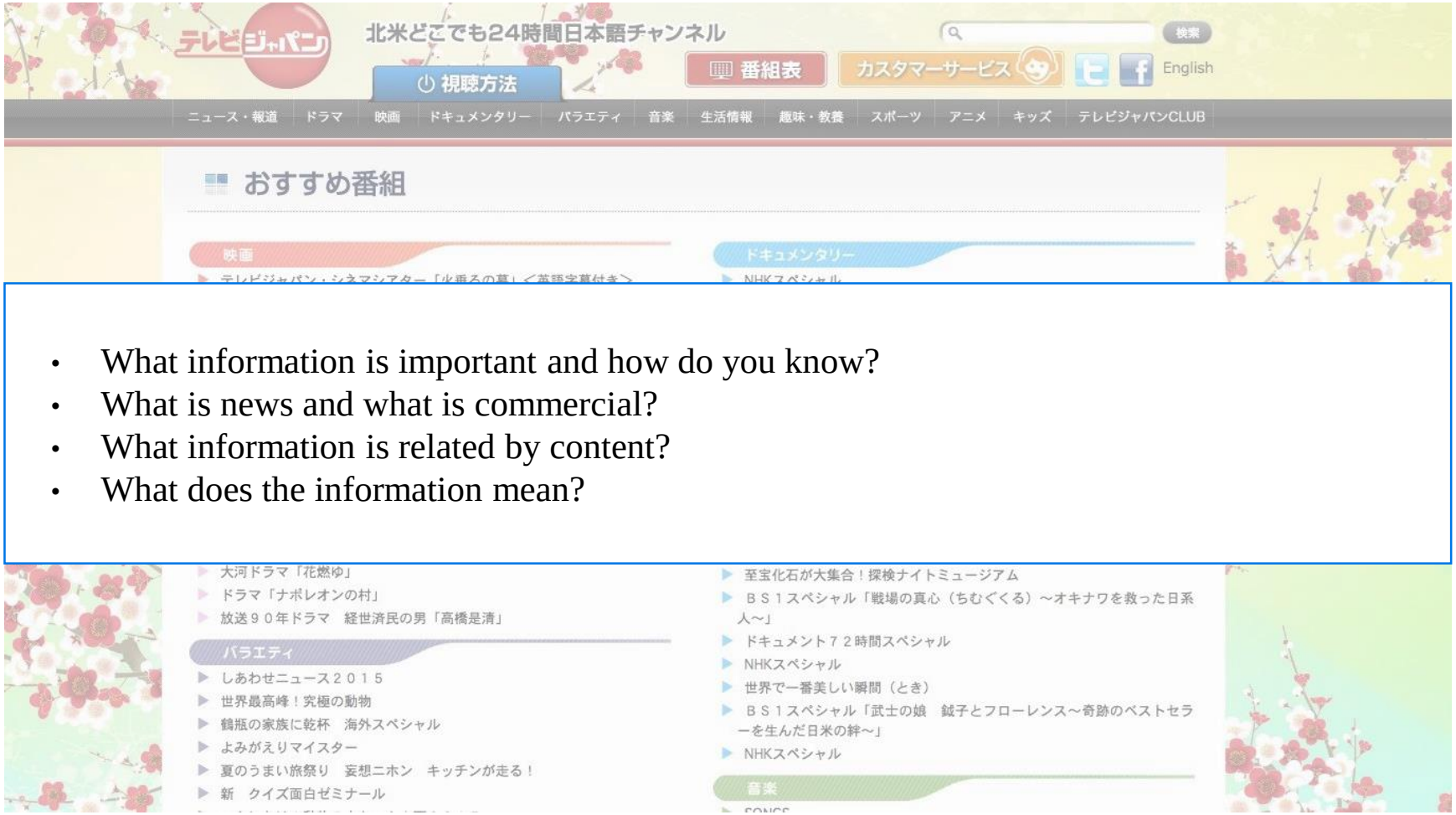
Web Challenges

Too much information with too little structure and made for human consumption

Web resources are heterogeneous in terms of contents, in terms of structure, and in terms of character encoding

Humans can derive new (implicit) information from given pieces of information; machines are required to do the same

Understanding the Web



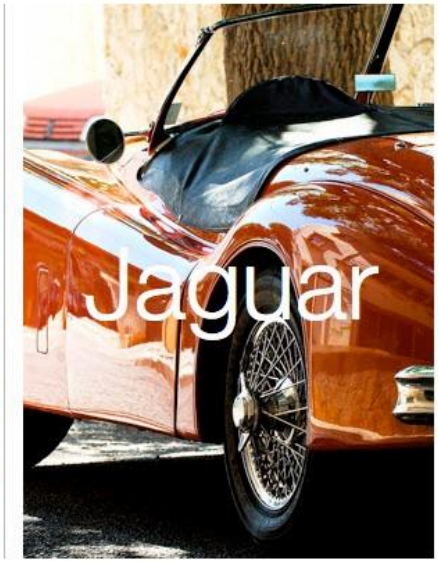
- What information is important and how do you know?
- What is news and what is commercial?
- What information is related by content?
- What does the information mean?

The (Document) Web for Humans

- The web is based on the markup language HTML
- HTML describes
  - How information is presented
  - How information is linked
  - But not, what the information means

The Information Retrieval Dilemma

- Ambiguity of natural language (polysemy)
- Different words/ expressions for the same concepts (synonyms, metaphors)

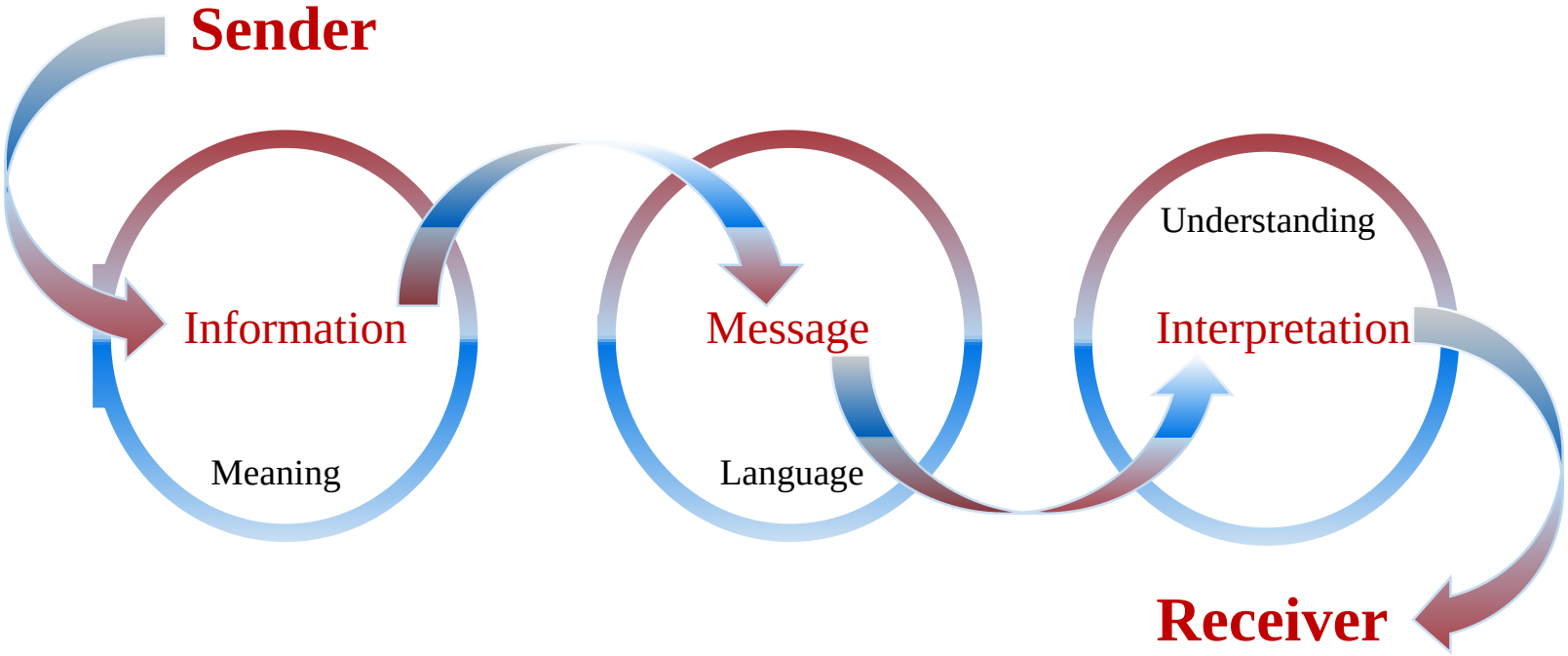


- Implicit Knowledge – Information does not have to be specified explicitly, but must be derived via logical deductions from available information

- **What is the meaning?**

Meaning and Comprehension

So what does correct interpretations depends on?



Syntax

- =[greek] Arrangement, Ordering

- In grammer syntax denotes the study of the principles and processes by which sentences are constructed in particular languages.

- In formal languages, syntax is just a set of rules, by which well formed expressions can be created from a fundamental set of symbols (alphabet).

- In computer science, syntax defines the normative structure of data.

Cannot specify the meaning

Semantics

- =[greek] pertains to the character, the study of meaning
- is part of the linguistics focussed on Sense and Meaning of language or symbols of language.
- is the study of interpretation of signs or symbols as used by agents or communities within particular circumstances and contexts.
- Semantics asks, how sense and meaning of complex concepts can be derived from simple concepts based on the rules of syntax.

Cannot monitor environment/ context

Context

- denotes the surrounding of a symbol (concept) and its relationship with the surrounding expression (concepts)
- Context denotes all elements of any sort of communication that define the interpretation of the communicated content
- We distinguish
  - General context
    - (place, time, interrelation of action in a message)
  - Personal or social contexts
    - (relation between sender and receiver of the message)

Cannot clarify the intention

Pragmatics

- reflects the intention by which the language is used to communicate a message.
- In linguistics pragmatics denotes the study of applying language in different situations.
- It also denotes the intended purpose of the speaker.
- Pragmatics studies the ways in which context contributes to meaning.

Cannot replace the world knowledge

Experience

- Experience considers all information that you have learned and put in context with the world you are living in.

- Experience in this sense also often is referred to as common sense knowledge or world knowledge.

Defines the meaning and comprehension

- Correct interpretations depends on
  - Syntax
  - Semantics
  - Context
  - Pragmatics
  - Experience

Successful Communication

- For successful communication
  - Information has to be correctly transmitted (syntax)
  - The meaning (Semantics) of the transmitted information must be correctly interpreted (Understanding)
- Understanding depends on
  - The context of both sender and receiver
  - The pragmatics of its sender
- Context of sender and receiver depends on
  - The experience (knowledge of the world) of both sender and receiver

Experience

Concept

Context

Experience

symbolizes

refers to

Symbol

stands for

Object

"Jaguar"

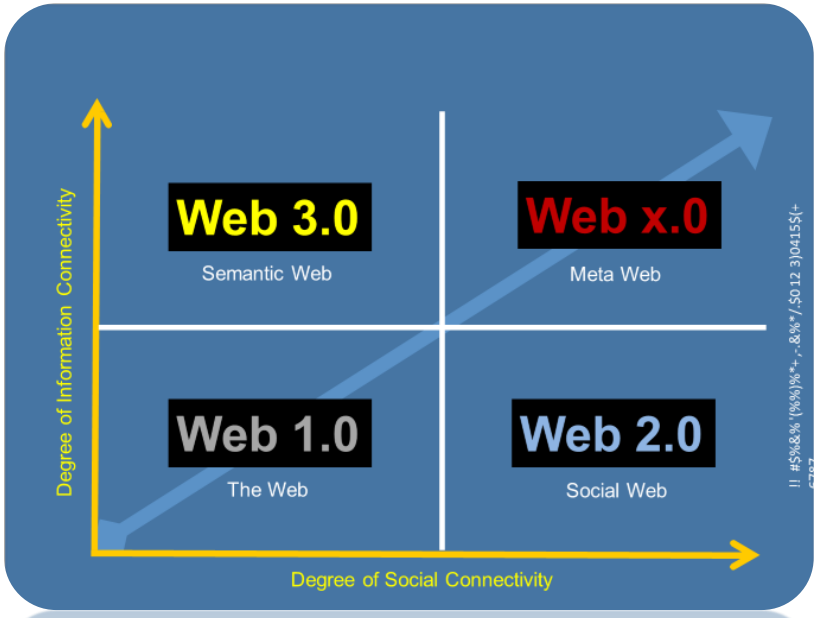
Pragmatics

In the (traditional) Web there is no explicit semantics

Evolution of web can be categorized by the prospects of successful communication

Evolution of Web

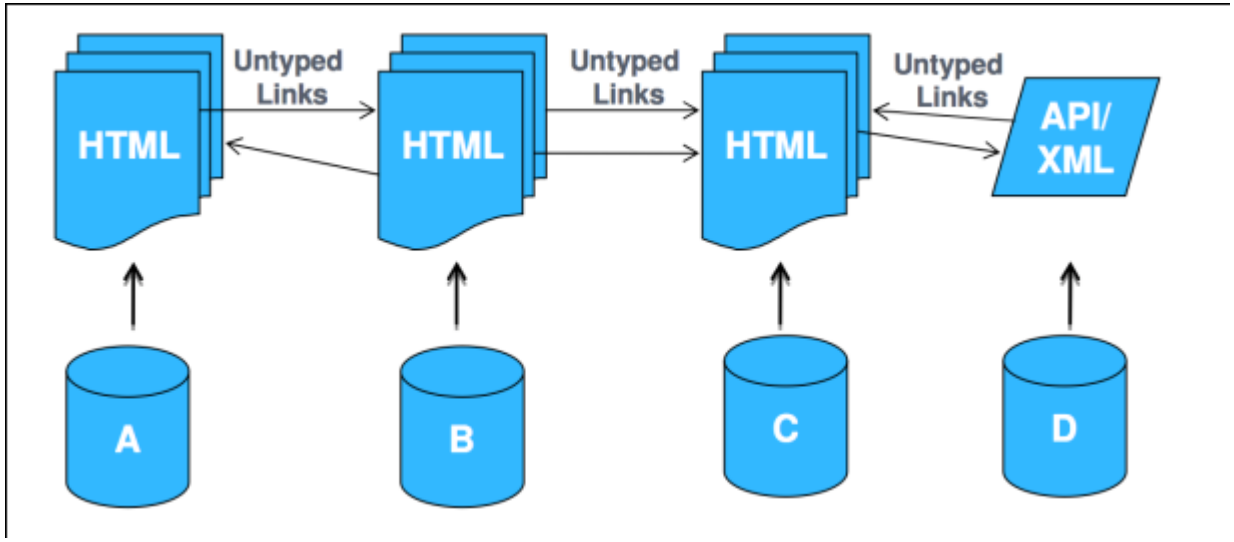
- Web 1.0 – The static web
- Web 2.0 – The writing and participating web
- **Web 3.0 – The semantic executing web**
- Web 4.0 – "Mobile Web"
- Web 5.0 - Open, Linked and Intelligent Web = Emotional Web



Web 1.0 – Info Centric Web

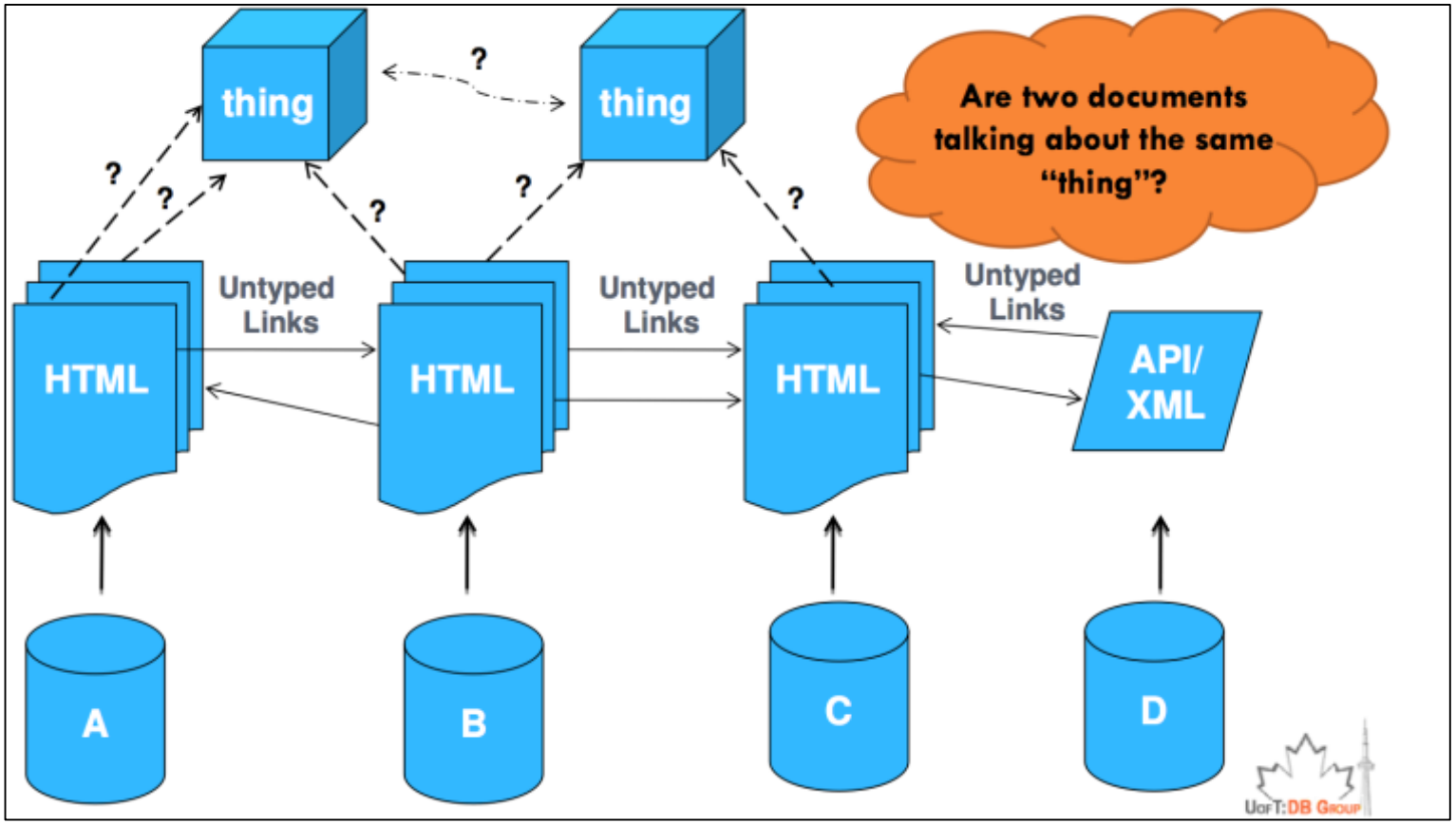
- The first generation of the World Wide Web (WWW), characterized by separate **static** websites.
- It is one-way broadcasting.
- It is invented 1989 by Tim Berners- Lee.
- It was widely used between 1998 and 2001, and it is still used beside Web 2.0 in almost all web sites.

Web of Documents



- Primary objects: **documents**
- Degree of structure in data: **low**
- Semantics of content: **Implicit**
- Designed for: **human consumption**
- Links between **documents**

Web of documents: The problem



The lack of active interaction of common users with the web

Web 2.0 – People Centric Web

Web 2.0 has no single definition but can be explained through a series of Internet trends, one being the empowerment of the user.

Deitel, Paul J; Deitel, Harvey M

- The year 1999 marked the beginning of a Read-Write-Publish era
- A non-technical user can actively interact & contribute to the web using different blog platforms.
- Ability to contribute content and interact with other web users.
- This era empowered the common user with a few new concepts like Blogs, Social-Media & Video-Streaming.
- Publishing your content is only a few clicks away! Few remarkable developments of Web 2.0 are Twitter, YouTube, Flickr and Facebook.

Web 3.0 – Machine Centric Web

- Web 3.0 refers to a third generation of internet based services that collectively allow the emergence of Intelligent Semantic Web

- Semantic Web is a group of methods and technologies to allow machines to understand the meaning - or "semantics" - of information on the World Wide Web.

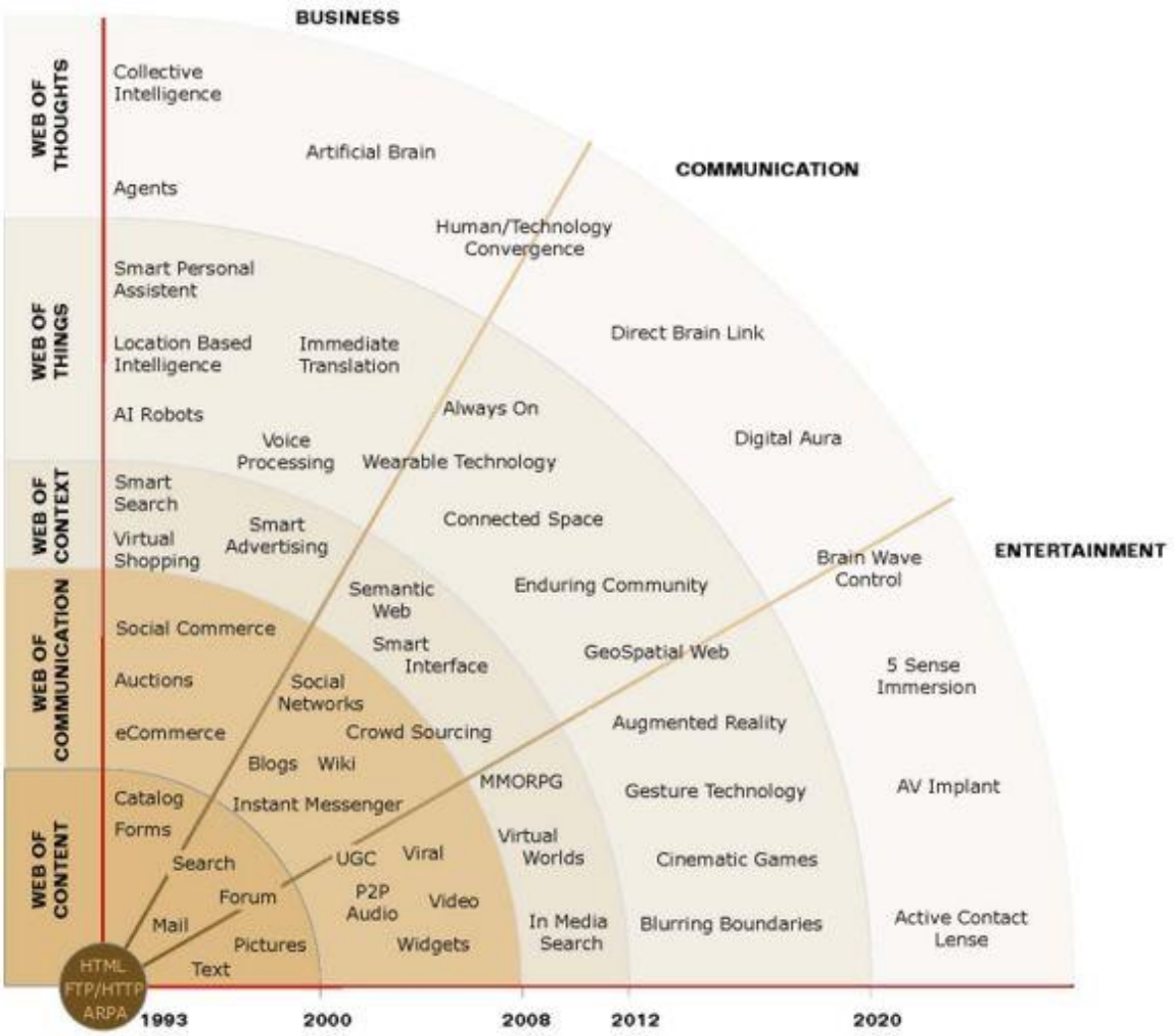
- The semantic web is a vision of information that is understandable by computers, so computers can perform more of the tedious work involved in finding, combining, and acting upon information on the web.

Comparison

Crawl	Walk	Run
Web 1.0	**Web 2.0**	**Web 3.0**

trendone
NILS MÜLLER COMMUNICATIONS

THE WEB EXPANSION
FROM WEB OF THINGS TO WEB OF THOUGHTS



https://flatworldbusiness.files.wordpress.com/2010/11/smartweb_web_5-0_evolution_confidential_-v004.jpg

Understanding Semantic Web More
Web of data: The problem

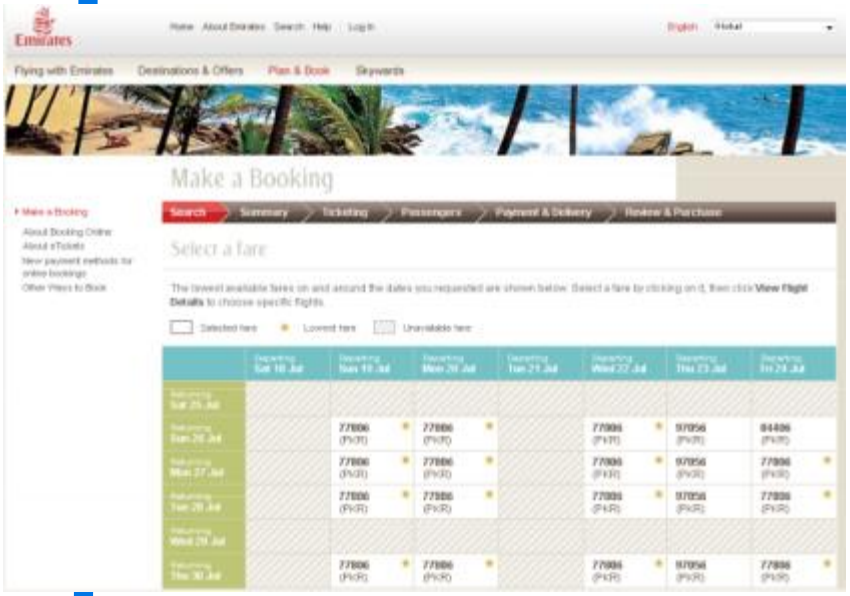
- How about this query:
  - *How many romantic comedy Hollywood movies are directed by a person who is born in a city that has average temperature above 15 degrees!?*
- You need to:
  - Find reliable sources containing facts about movies, directors, birthplaces of famous artists/directors, average temperature of cities across the world, etc.
    - The result: several lists of thousands of facts
  - Integrate all the data, join the facts that come from heterogeneous sources

Understanding the Problem

- Let's organize a trip to Budapest using the Web!
- You may want to know something about Budapest; look for some photographs…

Understanding the Problem

- Find a proper flight



Understanding the Problem

- Find a proper hotel

Resolve Data Heterogeneity

- There are multiple ways to encode same information
  - Muhammad, Mohammad, Mohammed, Muhammed (12 different spellings)
  - Barak Obama, Barak H. Obama, Barak Hussain Obama, Mr. Obama, President of America, President of United States of America, President of USA, American President.
- It is simply difficult to distinguish the meaning between these two sentences:
  - I am a computer engineer.
  - I am a computer engineer, you may think. Well, . .
- Only Web of Data is not the solution
- We need to extend the current Web to a **standard** way for a "Web of Data"

Semantic Web

The Technology & Experts Statements

- It involves publishing in languages specifically designed for data: Resource Description Framework (RDF), Web Ontology Language (OWL), and Extensible Markup Language (XML):
  - HTML describes documents and the links between them.
  - RDF, OWL, and XML, by contrast, can describe arbitrary things such as people, meetings, or airplane parts.

- Tim Berners-Lee
  - "…, you'll Have access to an unbelievable data resource ".
- Nova Spivak
  - "…It's a set of standards that turns the Web into one big database," .
  - " …I call it the World Wide Database".

References

- Lecture Notes of Dr Haral Sack, Hasso-Plattner-Institute for IT Systems Engineering [Knowledge Engineering with Semantic Web Technologies]
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Thanks.

Next Lecture – Paradigm of Semantic Web