

# Intelligent Internet Technologies



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Lectures 1-2.

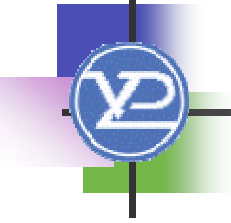
**Introduction to the course.  
Semantic Web Architecture**

Alexandra V. Vitko



KNURE, AI Department, [alexandra\\_vitko@yahoo.com](mailto:alexandra_vitko@yahoo.com)

# Outline

- 
- Objective of the course, relation to other courses in IDSS curriculum
  - Course structure
  - Literature and Web-sources of information
  - W3C Consortium
  - Evolution of Internet
  - Semantic Web Initiative
  - Architecture of Semantic Web
  - Semantic Web Challenges

# Internet Growth (to 2006)



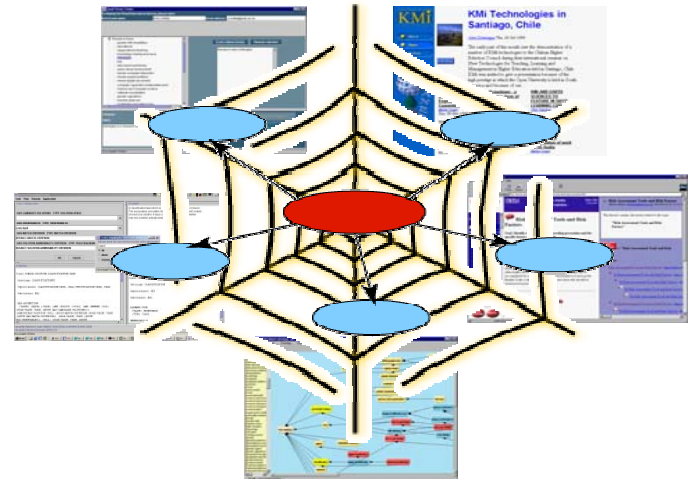
## WORLD INTERNET USAGE AND POPULATION STATISTICS

World Regions	Population ( 2006 Est.)	Population % of World	Internet Usage, Latest Data	% Population Penetration	Usage % of World	Usage Growth 2000-2006
<a href="#"><u>Africa</u></a>	915,210,928	14.1 %	32,765,700	3.6 %	3.0 %	625.8 %
<a href="#"><u>Asia</u></a>	3,667,774,066	56.4 %	378,593,457	10.3 %	35.2 %	231.2 %
<a href="#"><u>Europe</u></a>	807,289,020	12.4 %	311,406,751	38.6 %	28.9 %	196.3 %
<a href="#"><u>Middle East</u></a>	190,084,161	2.9 %	19,028,400	10.0 %	1.8 %	479.3 %
<a href="#"><u>North America</u></a>	331,473,276	5.1 %	231,001,921	69.7 %	21.5 %	113.7 %
<a href="#"><u>Latin America/Caribbean</u></a>	553,908,632	8.5 %	85,042,986	15.4 %	7.9 %	370.7 %
<a href="#"><u>Oceania / Australia</u></a>	33,956,977	0.5 %	18,364,772	54.1 %	1.7 %	141.0 %
<b>WORLD TOTAL</b>	6,499,697,060	100.0 %	1,076,203,987	16.6 %	100.0 %	198.1 %

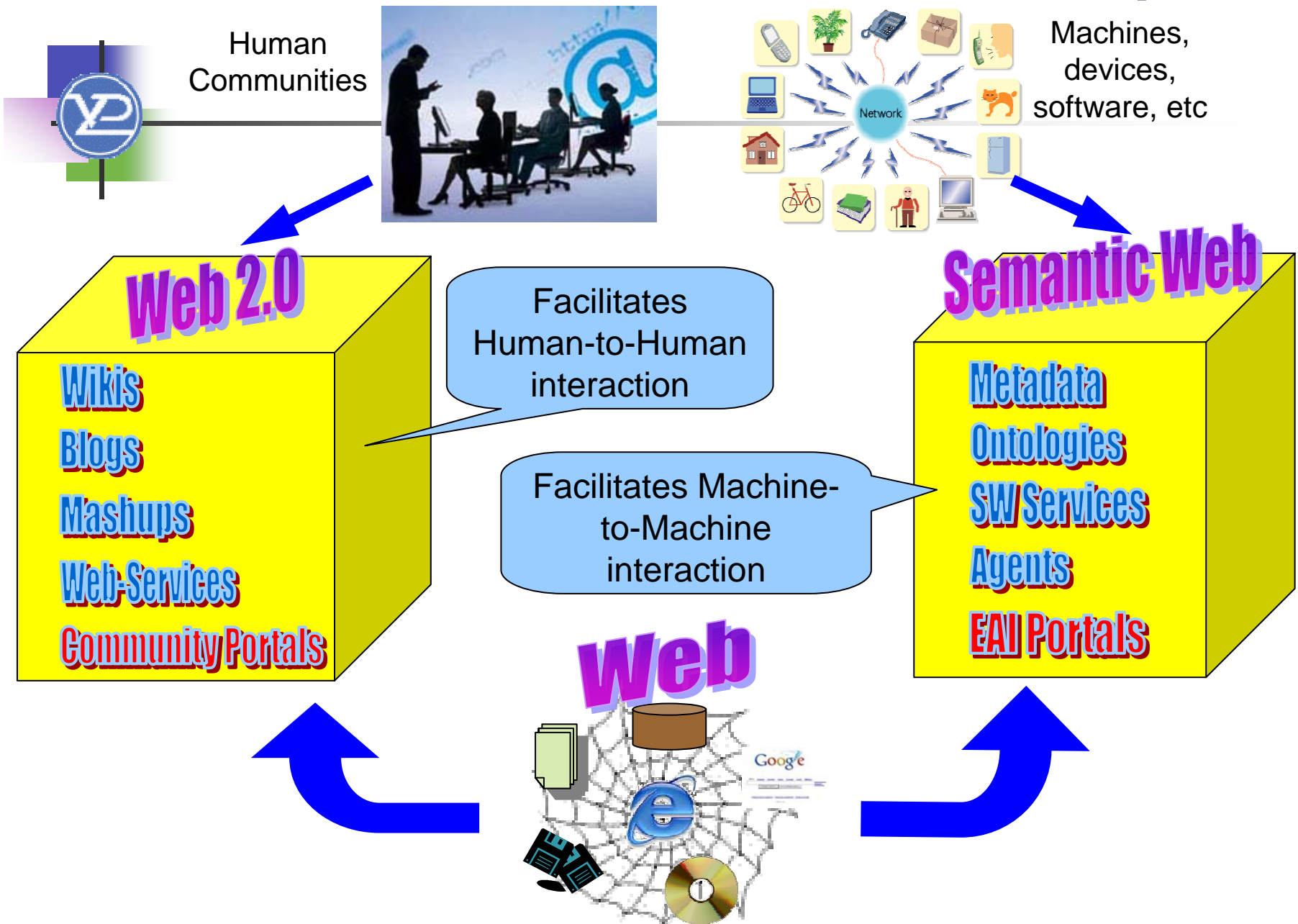
"Over 1 Billion Served"

# Web: Different Versions ?

- Traditional WWW
- Semantic Web
- Web 2.0 ?
- Web 3.0 ???
- ??????????????



# Two trends of Web development



# Web 2.0 definitions

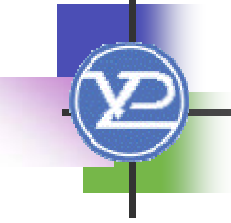


The term "Web 2.0" describes the changing trends in the use of **World Wide Web** technology and **web design** that aim to enhance creativity, communications, secure information sharing, collaboration and functionality of the web.

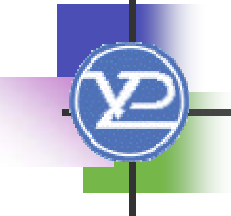
Web 2.0 concepts have led to the development and evolution of **web-culture communities** and hosted services, such as **social-networking sites**, **video sharing sites**, **wikis**, **blogs**, and **folksonomies**.

"Web 2.0 is the business revolution in the computer industry" (Tim O'Reilly)

# SW and Web 2.0

- 
- Not alternatives !
  - Web 2.0 does not deliver inter-application integration
  - SW does not provide cool interfaces to data
  - Together... interesting

# Web 3.0 ???

- 
- **Web 3.0** is one of the terms used to describe the evolutionary stage of the Web that follows Web 2.0.
  - Highly speculative term

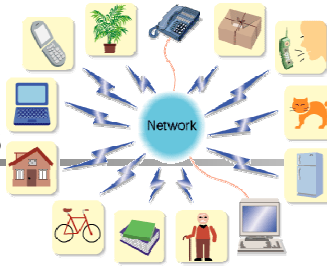


# Three trends of Web development

Human  
Communities

Machines,  
devices,  
computers

Applications,  
services, agents



Facilitates  
Machine-to-  
Machine  
interaction

Facilitates  
Software-to-  
Software  
interaction



Facilitates  
Human-to-  
Human  
interaction

**Web of Things**

**Semantic Web**

**Web 2.0**

- Wikis
- Blogs
- Mashups
- Community Portals

**Web of Things**

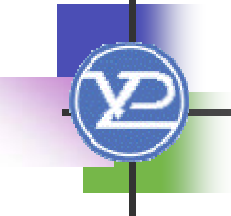
- Smart Spaces
- RFID
- Embedded Systems
- Sensor Networks

**Semantic Web**

- Metadata
- Ontologies
- Web Services
- Agents
- EAI Portals



# Smile ☺

- 
- WEB 0.0 - юзер мечтает законнектиться с кем или чем-либо
  - WEB 1.0 - юзер получает контент
  - WEB 2.0 - юзер создаёт контент
  - WEB 3.0 - коллективное создание контента
  - WEB 4.0 - контент думает за юзера
  - WEB 5.0 - контент общается с контентом
  - WEB 6.66- контент удаляет юзеров, поняв что они бессмысленны

# Objective of the course



Objective: to introduce to students the newest Internet technologies, that use AI techniques for data and knowledge representation and processing, Internet search, Web adaptation.

Special attention is paid to the new form of Internet:

**Semantic Web**



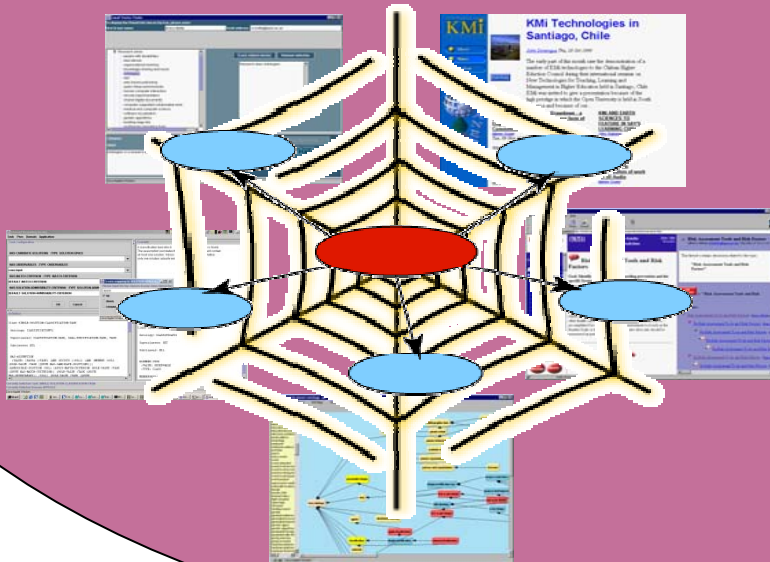
# Intelligent Internet Technologies



Knowledge  
Presentation

Knowledge  
Usage

**Semantic  
Web**



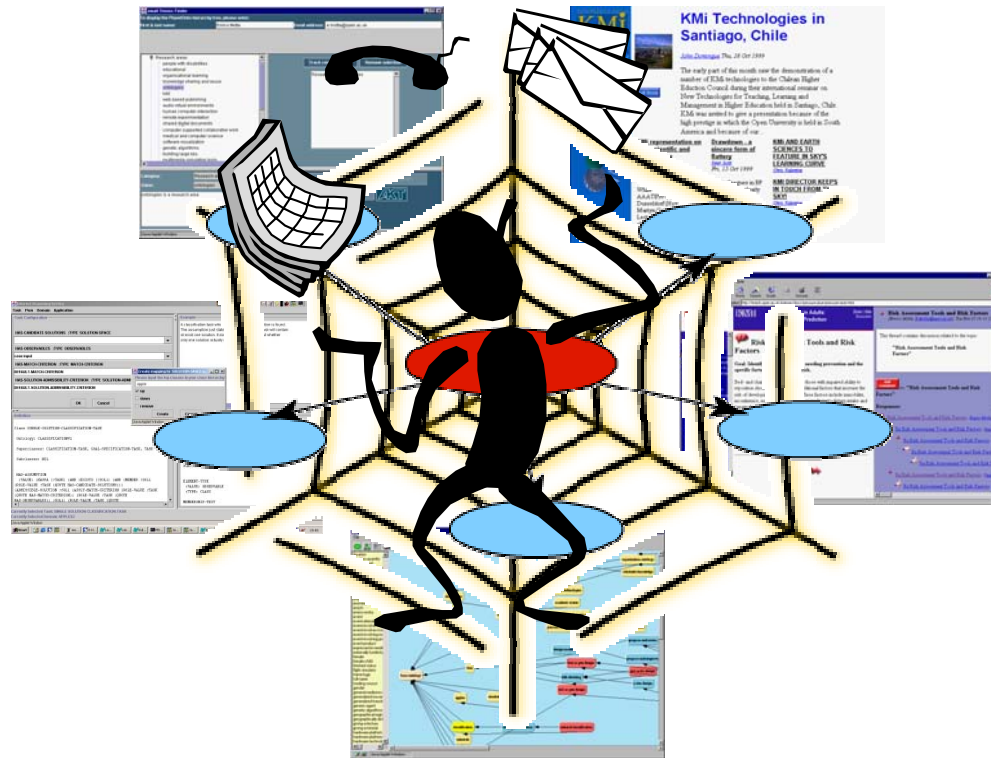
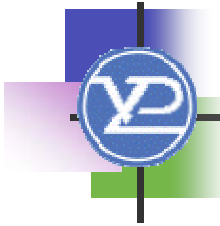
**Intelligent  
Agents**



**Search Engines**

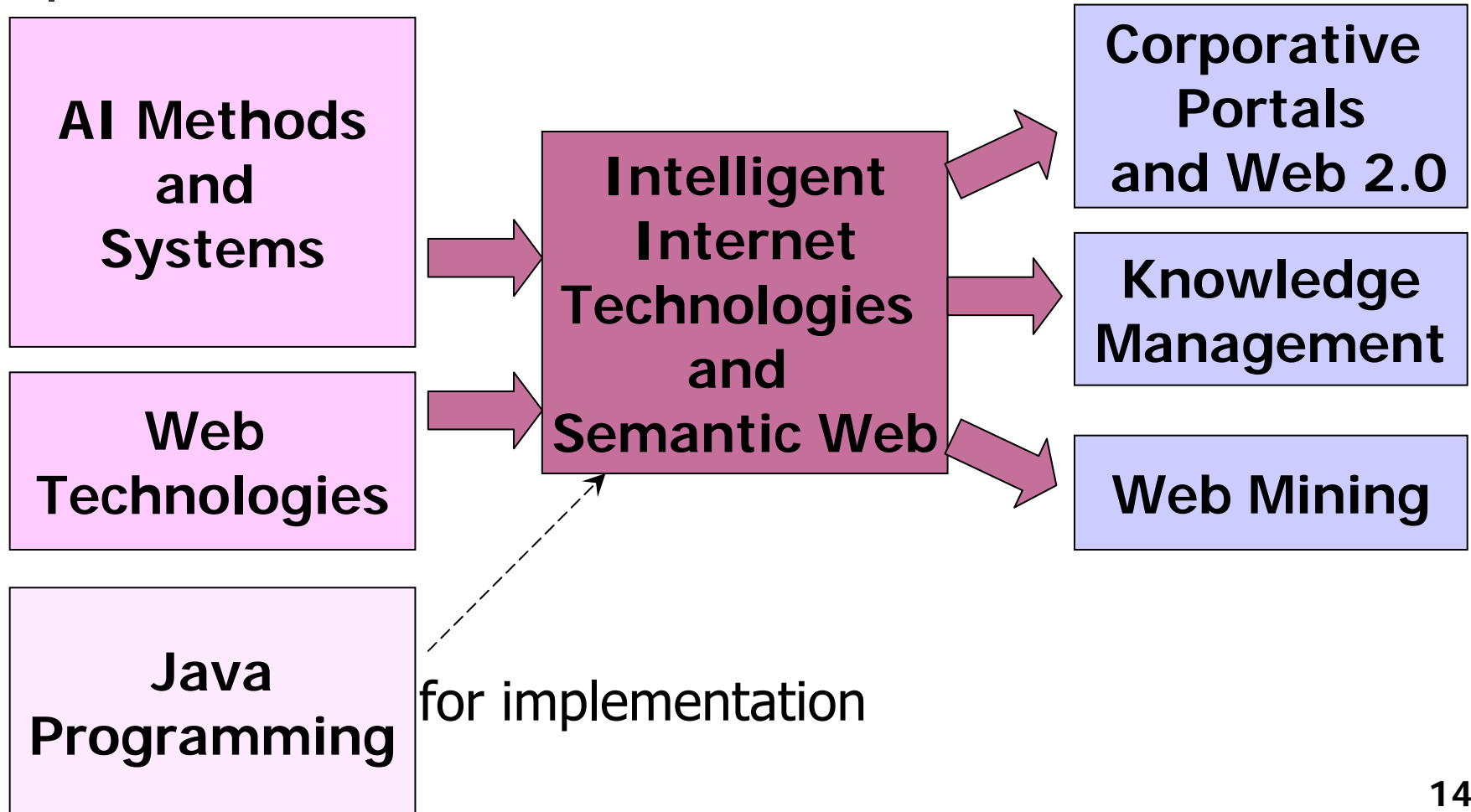
**Web Mining**

# Intelligent Agents and Semantic Web



Managing and integrating web resources with the help of Semantic Web - are among the basic tasks of an intelligent agents

# Relation to other courses in IDSS curriculum



# Course Structure



2 semesters

30 lectures

10 laboratory works

Pass (6 sem.), Exam (7 sem.)

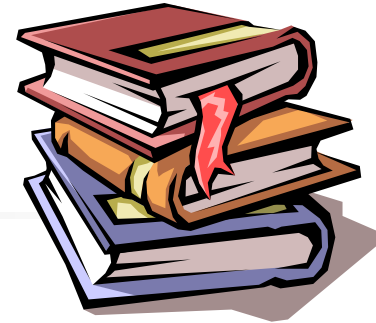
Course project (7 sem.)

Structured representation  
of data and knowledge  
in the Web

Semantic representation  
of data and knowledge  
in the Web

Implementations

# Literature



- Specifications of XML, XML Schema, DOM, RDF, RDF Schema, OWL, etc. (W3C consortium)
- Practical RDF (Shelley Powers)
- any books on these topics (book stores)

## Lecture slides:

- DL KhNURE <http://dl.kture.kharkov.ua>





# Main Web-Source



W3C Consortium

<http://www.w3.org/>



<http://www.w3.org/standards/semanticweb/>

# The World Wide Web Consortium (W3C)

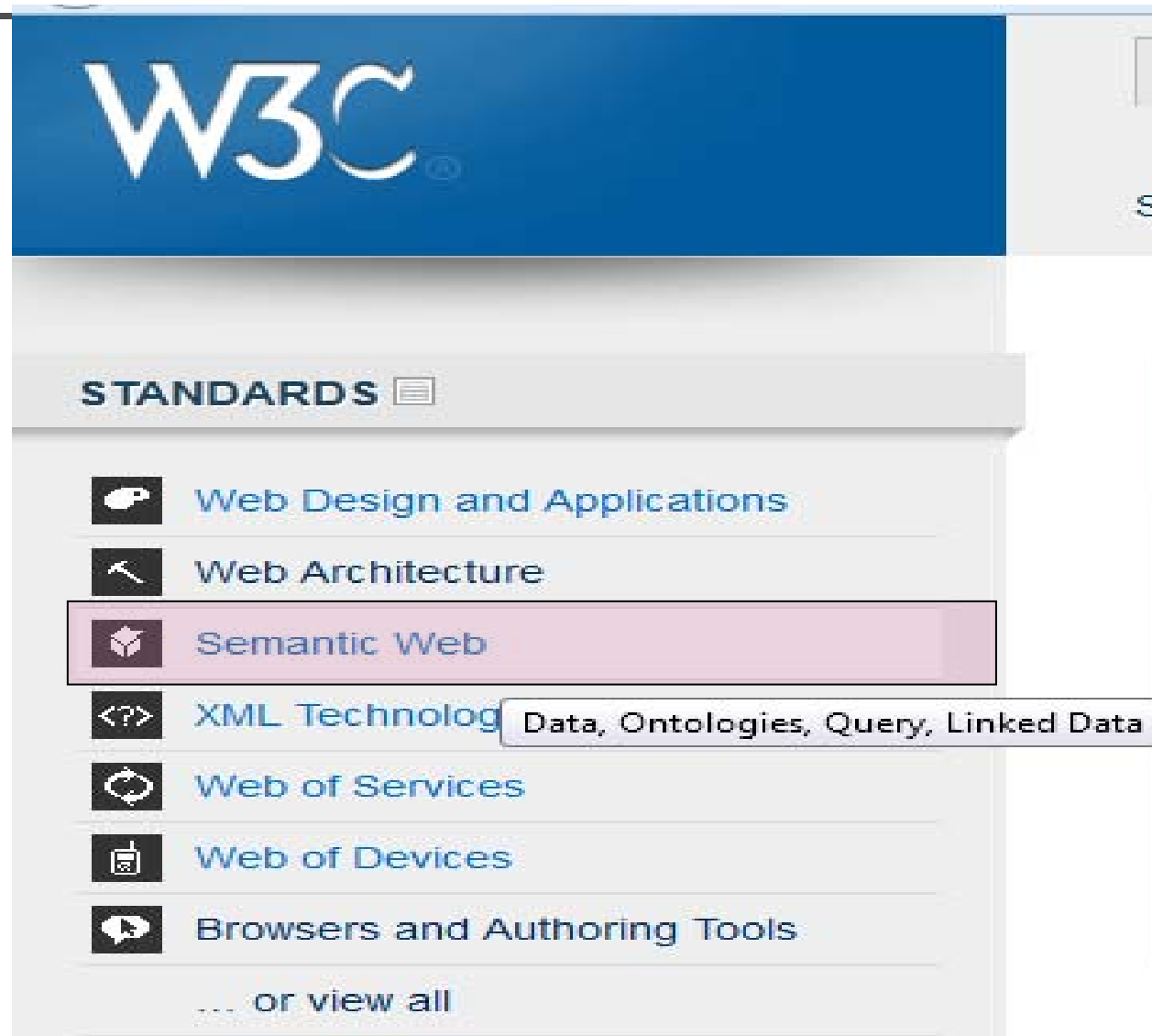


- W3C formed in 1994 (Chair Tim Berners Lee)

**to lead the Web to its full potential as a  
forum for information, commerce,  
communication, and collective  
understanding**

by developing common protocols that promote  
its evolution and ensure its interoperability

# Current W3C Trends



# W3C Semantic Web Activity



- has been subsumed in December 2013, by the **W3C Data Activity**. That activity has a larger scope; new or current Working and Interest Groups related to “traditional” Semantic Web technologies are now part of that Activity.

# W3C Semantic Web Groups

- 
- Semantic Web Coordination Group
  - RDFa Working Group
  - RDF Working Group
  - Linked Data Platform Working Group
  - Semantic Web Interest Group
  - Semantic Web Health Care and Life Sciences Interest Group

# Why and Where Semantic Web ?



## WWW

- Number of Web-pages doubles each 6 months
- “Information” burst
- ICT needs comprehensive resource management technology

## Business



- Needs for integration of businesses
- Web Services for e-Business
- Standardization and interoperability problems

## Knowledge Management

- Consolidate and reuse experience
- Standardize knowledge sharing technology
- Needs for the intelligent tools to use human’s knowledge

# Summarizing the Problem:

## Computers don't understand meaning



*"My mouse is broken. I need a new one..."*



### Use of ontology

“My mouse is *broken*”  
vs. “My mouse is *dead*”

# Semantic Web



“The Semantic Web is a vision: the idea of having data on the Web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration and reuse of data across various applications”

<http://www.w3.org/sw/> (2000)



"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 cooperation."

-- Tim Berners-Lee, James Hendler, Ora Lassila, The Semantic Web, Scientific American, May 2001



# Semantic Web (2)



“The Semantic Web is a web of data”

“The **Semantic Web** provides a common framework that allows **data** to be shared and reused across **application**, **enterprise**, and **community** boundaries”

“The Semantic Web is about two things.

- It is about **common formats** for integration and combination of data drawn from diverse sources, where on the original Web mainly concentrated on the interchange of documents.
- It is also about **language** for recording how the data relates to real world objects. That allows a person, or a machine, to start off in one database, and then move through an unending set of databases which are connected not by wires but by being about the same thing.”

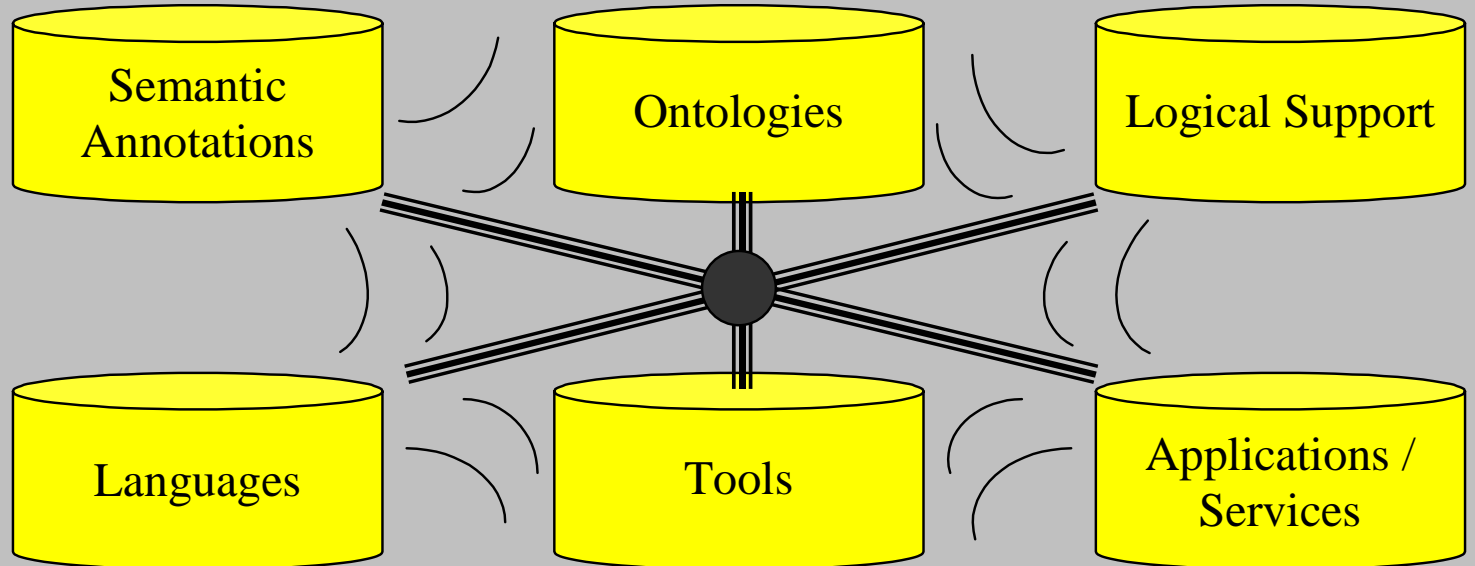


<http://www.w3.org/sw/> (now)

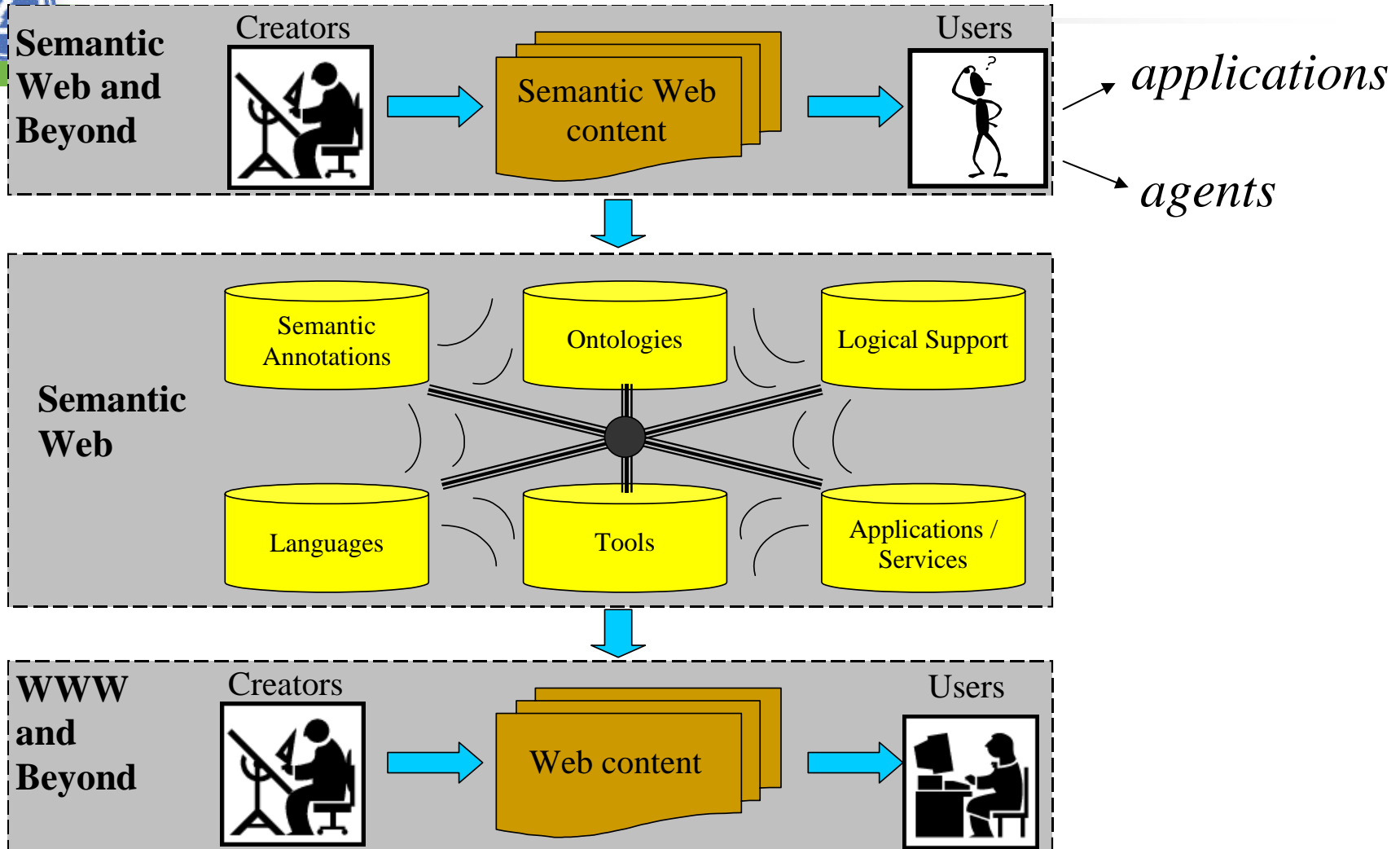
# Semantic Web Structure



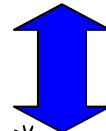
**Semantic  
Web**



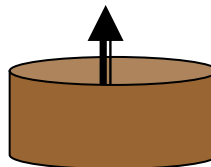
# Semantic Web: New “Users”



# Semantic Web Task Example: Resource Integration

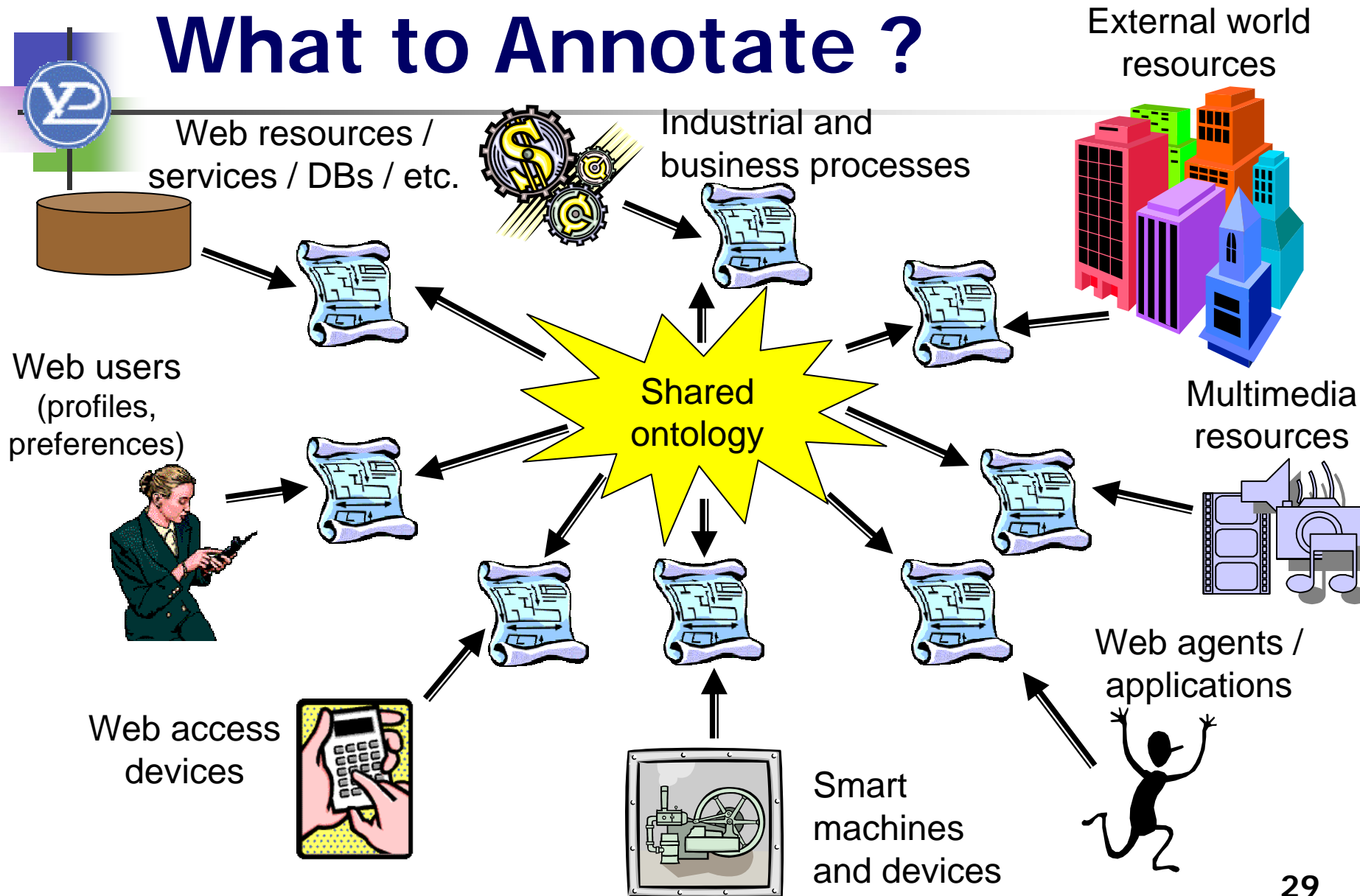


Semantic  
annotation

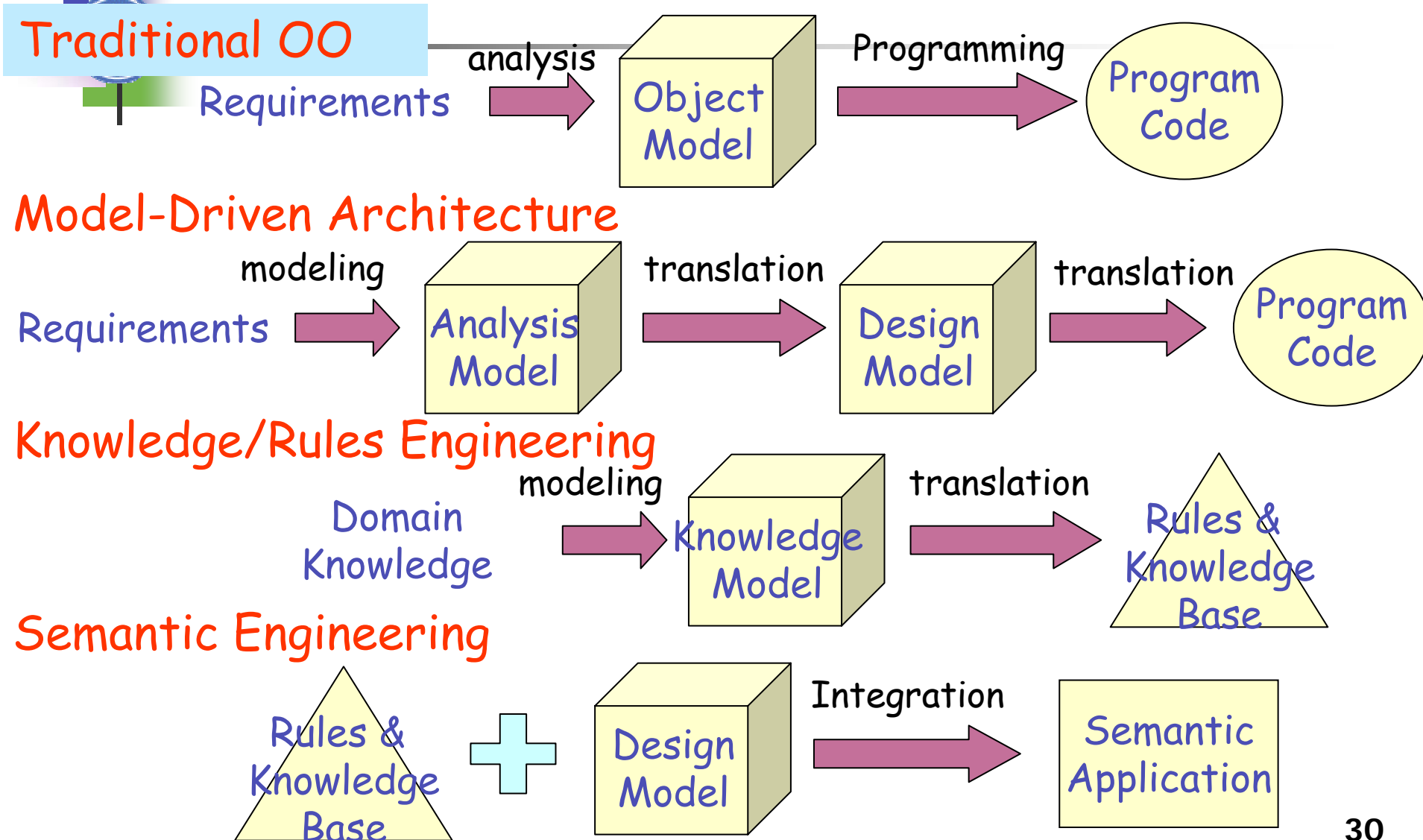


Web resources /  
services / DBs / etc.

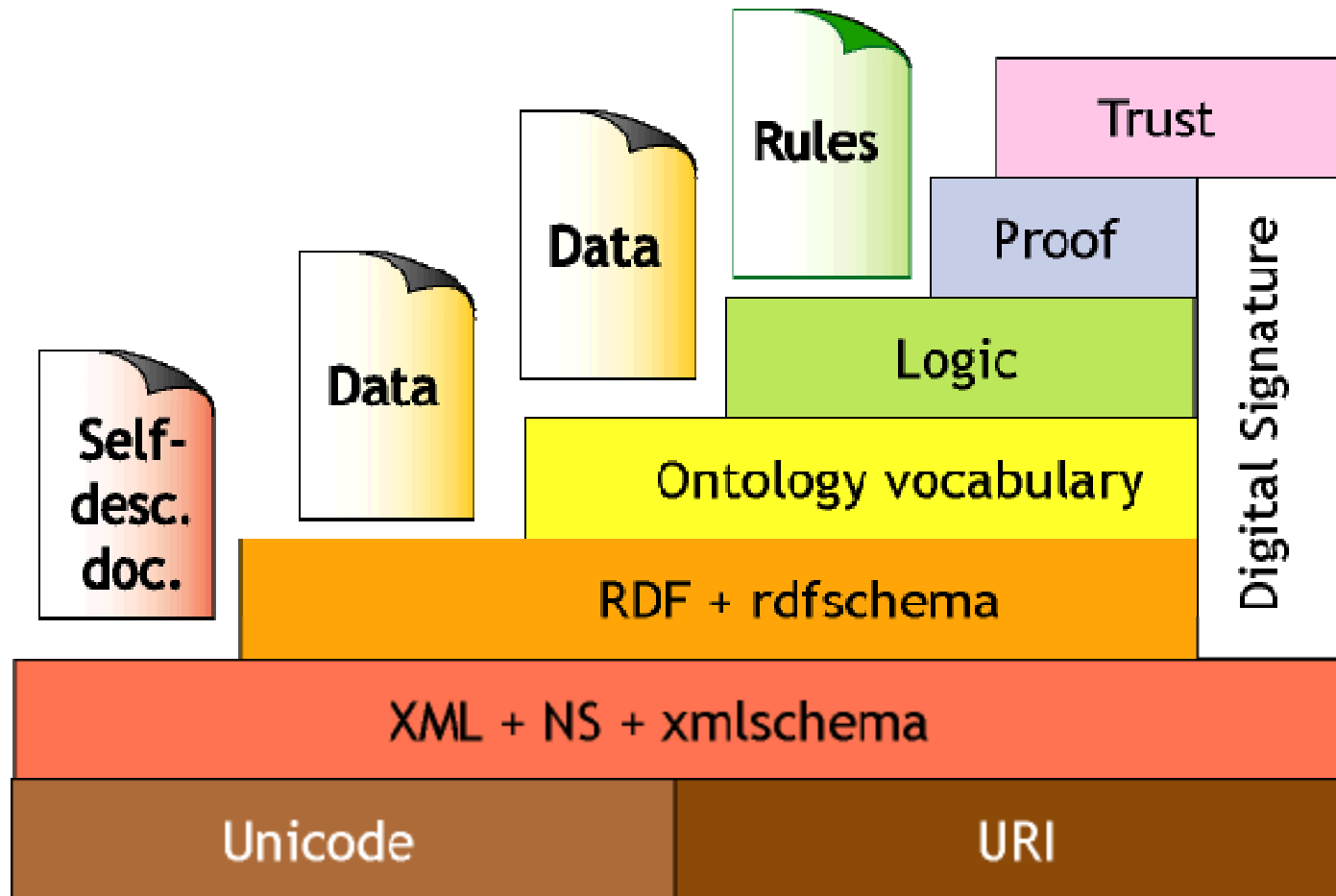
# Semantic Web: What to Annotate ?



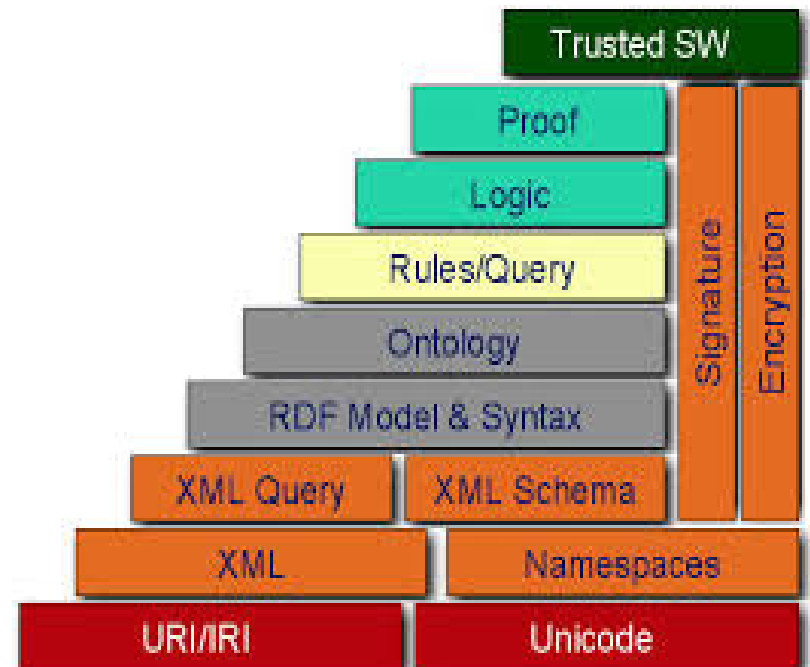
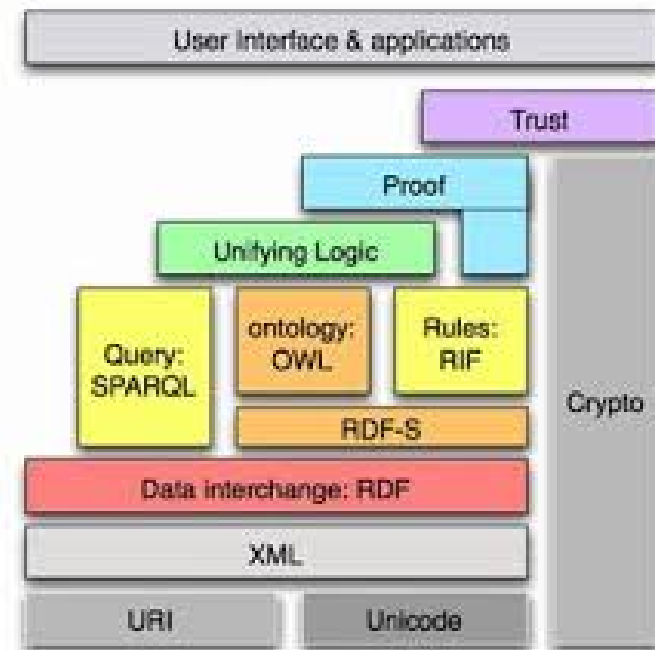
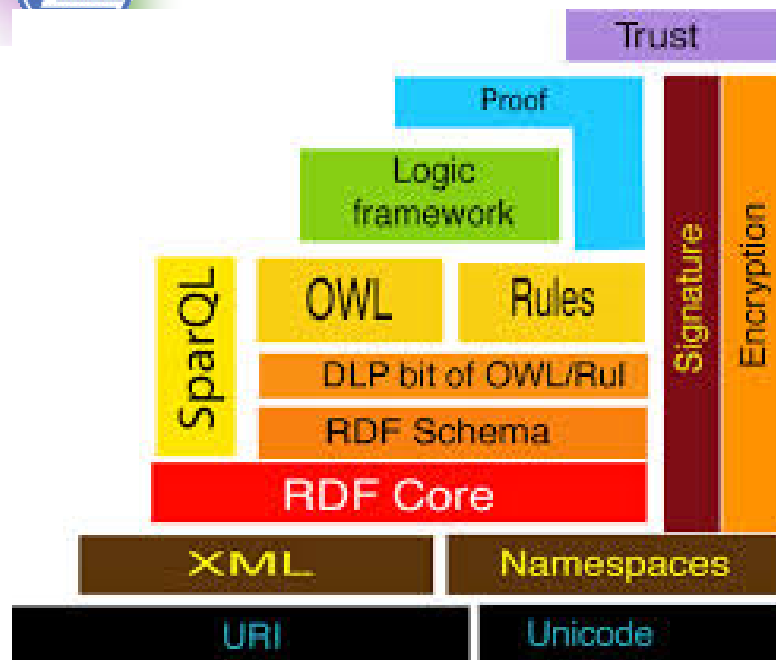
# Contrasting Semantic and Other Software Engineering Technologies



# Architecture of Semantic Web (Tim Berners-Lee)

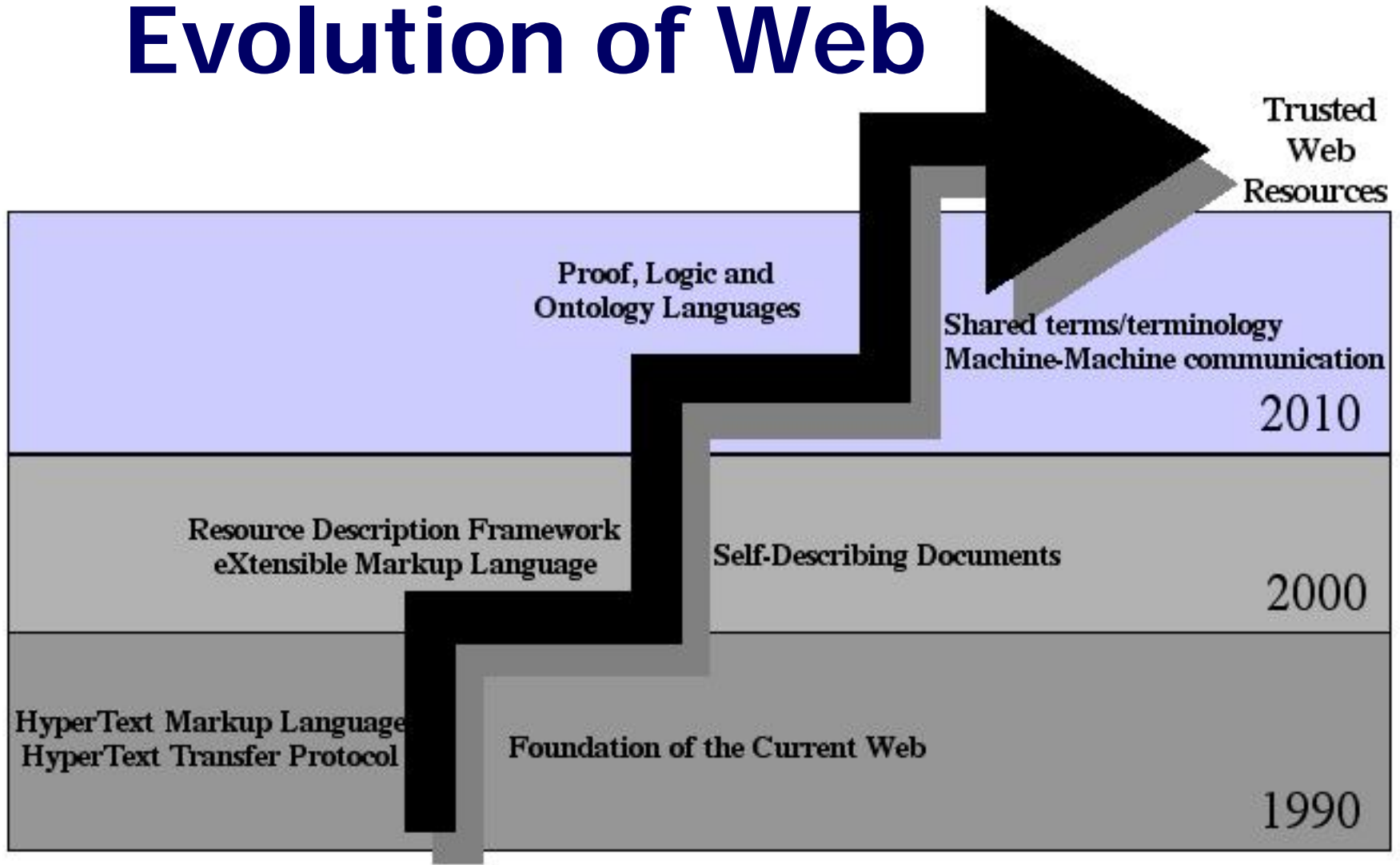


# Introduction to SW





# Evolution of Web



# Trend



- Data rather than Documents (XML)

last three-four years

- MetaData (Data about Data)  
(XML/RDF)

Current Cutting Edge

- Cross Sector Linkage  
(RDF, Inference)

Research projects

- Reasoning (RDF)

W3C research (DAML)

Data web

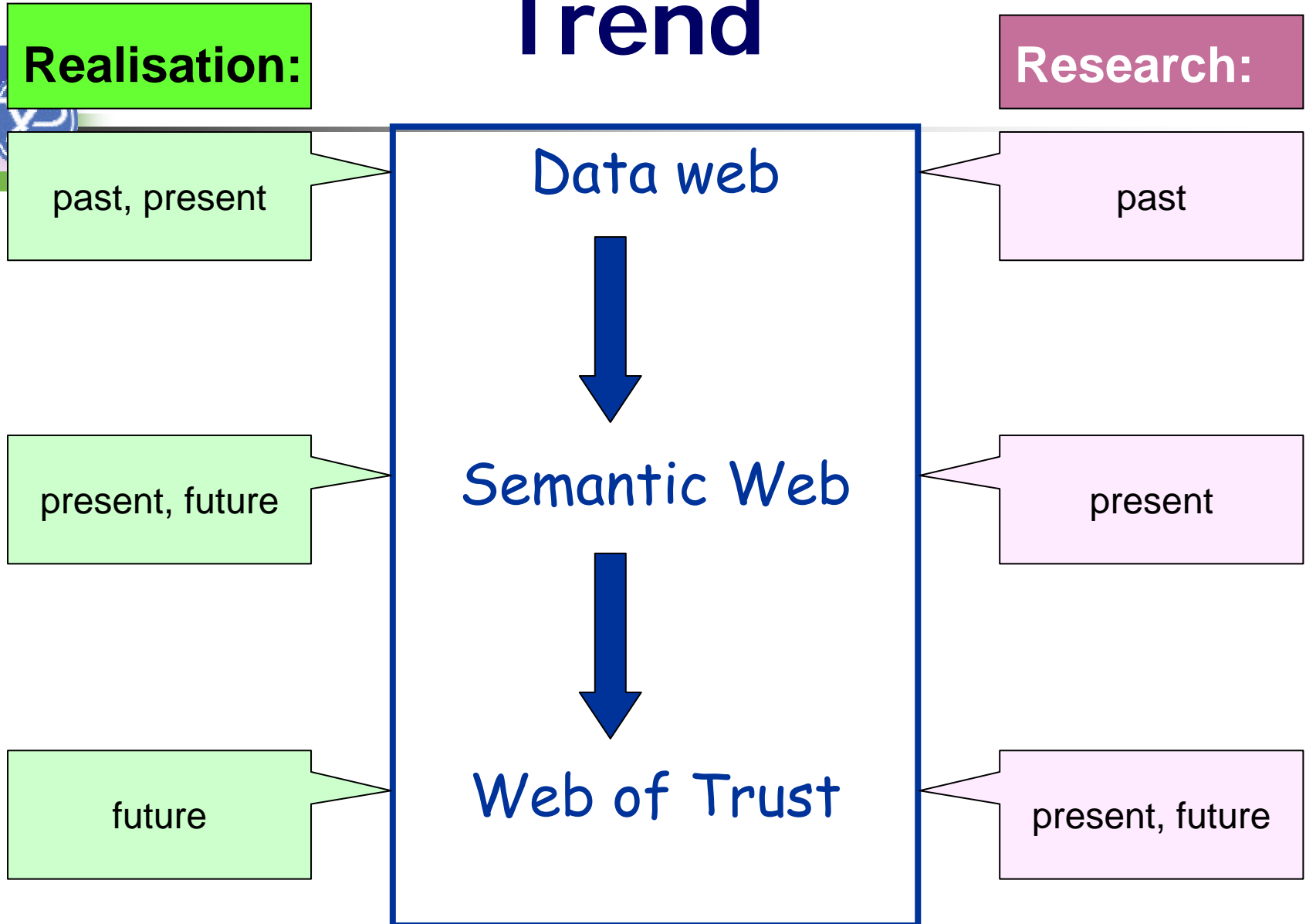


Semantic  
Web

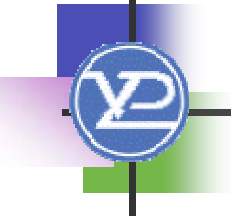


Web of  
Trust

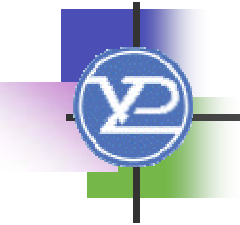
# Trend



# Support Technologies

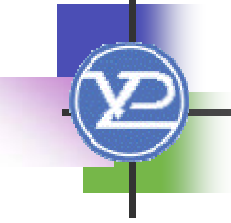
- 
- Also specific trust technologies in support role
    - P3P
    - XML Signature
    - XML Encryption

# Privacy

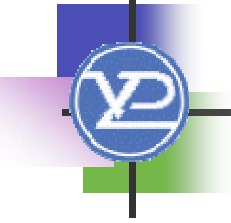


- Platform for Privacy Preferences (P3P)
- Concerns about privacy of personal data on the Web
- Allows:
  - Web service providers to make a formal statement of their privacy policies.
  - Users to set their privacy preferences
  - Manual or automatic comparison of preferences against policy.

# Digital Signatures

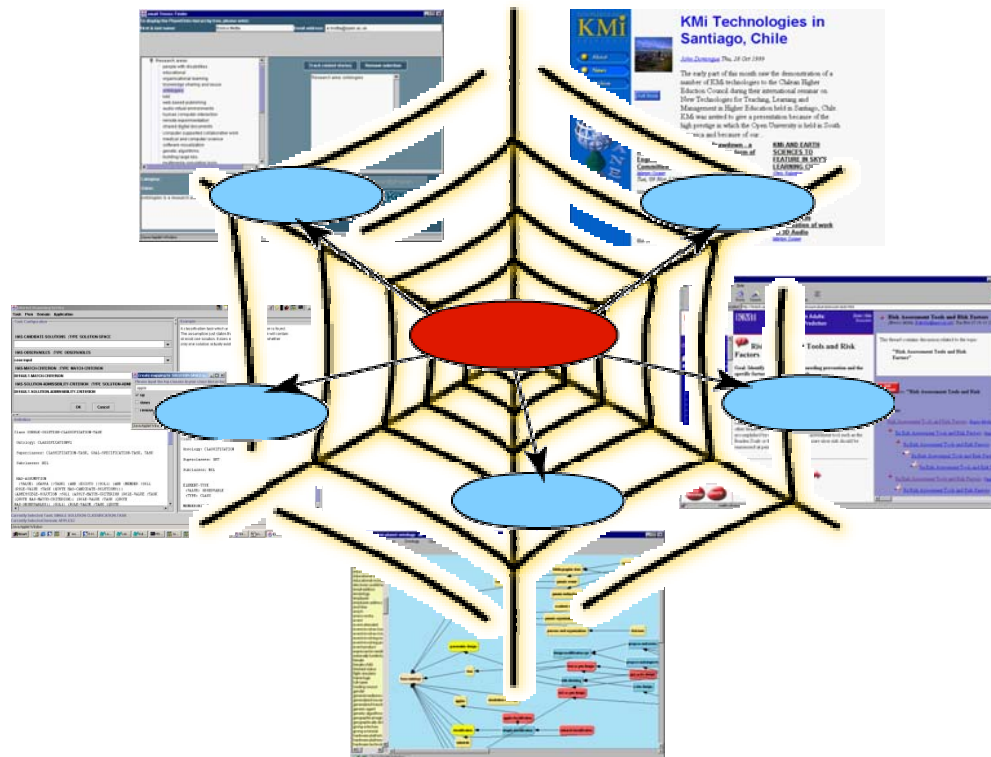
- 
- XML Signature
  - Develop a XML syntax used for representing signatures on digital content and procedures for computing and verifying such signatures.
  - Requires Canonical XML

# Encryption

- 
- XML Encryption
  - Developing a process for encrypting/decrypting digital content (including XML documents and portions thereof)
  - an XML syntax used to represent the
    - (1) encrypted content and
    - (2) information that enables an intended recipient to decrypt it



## Six Challenges for the Semantic Web





# Challenge 1: Availability of Content

- Currently, there is little Semantic Web content available. There is a need to create a set of annotation services (middleware) concerning static and dynamic web documents, which may include multimedia, and web services.

# Challenge 2: Ontology Availability, Development and Evolution



- Constructing of *kernel* ontologies to be used by all the domains.
- Managing evolution of ontologies and their relation to already annotated data.

# Challenge 3: Scalability of Semantic Web Content



- Once we have the Semantic Web content, we need to worry about how to manage it in a scalable manner, that is, how to organize it, where to store it and how to find the right content.

## Challenge 4: Multilinguality

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- Multilinguality plays an increasing role at the level of ontologies, of annotations and of user interface.

# Challenge 5: Visualization



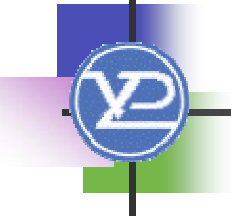
- With the increasing amount of information overload, intuitive visualization of content will become more and more important.

# Challenge 6: Semantic Web Language Standardization



- W3C consortium is producing recommendations on the languages and technology that will be used in Semantic Web area.
- In order to advance the state of the art in the Semantic Web, it is important that such standards appear fast and will be adopted by the community.

# Semantic Web Myths

- 
- *"The semantic Web is metadata for classifying documents"*
  - *"The semantic web is about hand-annotated web pages"*  
Such pages are interesting, but not the mainstay of semantic web: too much trouble!
  - *"The semantic web is mainly about content extracted from text"*  
No, it is primarily an interlingua for relational data and logic. bridges will always be important
  - *"The Semantic Web is about making one big ontology"*  
The semantic web is about a fractal mess of interconnected ontologies....
  - *"The semantic web ontologies must all be consistent"*  
Only the parts you are using together

# Summary



- At its start Internet enabled machines to exchange data
- 1<sup>st</sup> generation Internet enabled enormous amounts of information available, in human-readable form
- The next generation of the net is an “agent-enabled” (Semantic Web) which makes information available in machine-readable form ... enabling “agent” communication at a Web-wide scale
- The Semantic Web is a vision: the idea of having data on the web defined and linked in a way that it can be used by machines





**“Ask not what the Semantic Web Can do for you, ask what you can do for the Semantic Web”**

Hans-Georg Stork, European Union

<http://lsdis.cs.uga.edu/SemNSF>