Sematic Web and ontology Course

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Course Overview

- **Course Description**
- **Assessment**

Guidelines and Rules

- Keep your Mobile phones silent please.

- Alert me if I went faster than you could capture the content.

- Additional bonus for impressive answers

Course Overview

- Introduction to Semantic Web
- Knowledge Representation
- Ontology Engineering
- Building ontology using protégé
- RDF
- OWL
- SPARQL
- Linked Data
- Knowledge Graph

References

- A Semantic Web Primer, third edition, 2012 By Grigoris Antoniou, Paul Groth, Frank van Harmelen and Rinke Hoekstra

- Semantic Web for the Working Ontologist: Effective Modelling in RDFS and OWL, third edition, by Dean Allemang and Jim Hendler.

  - http://www.kevenlw.name/downloads/Ontologist.pdf

- Foundations of Semantic Web Technologies, 2009 by Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph

Assessment 100%

- ## Grading Basis
  - 10 % Assignment + Lab-work (protégé)
  - 10% Midterm
  - 10% Group project
  - 10 % presentation
  - 60% Final

- ## Late Policy
  – No late, -20% per day for any late submission
  – Cheating policy is –ve points

- ## Bonus Points
  – Bonus questions will occasionally offered to students. I may announce other opportunities for bonus points during the course.
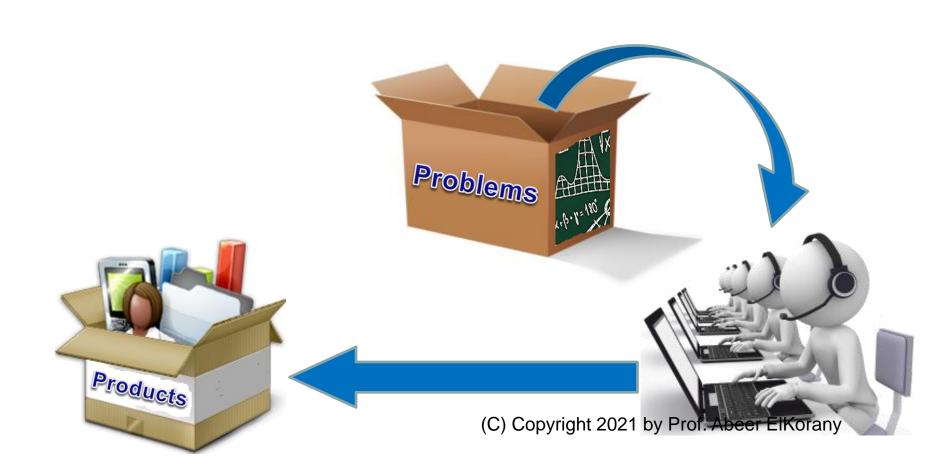
**PLEASE !!!
Download version:
Protégé 5.5.0**

Before We start the Academic Content

Good Engineers ...

... **converting problems into products**

Good Engineers vs. **Managers**

… **"talking" about products (buying, managing, selling)**

Good Engineers vs. **Advanced Users**

We will *not* waste your time with basics or fundamentals

API

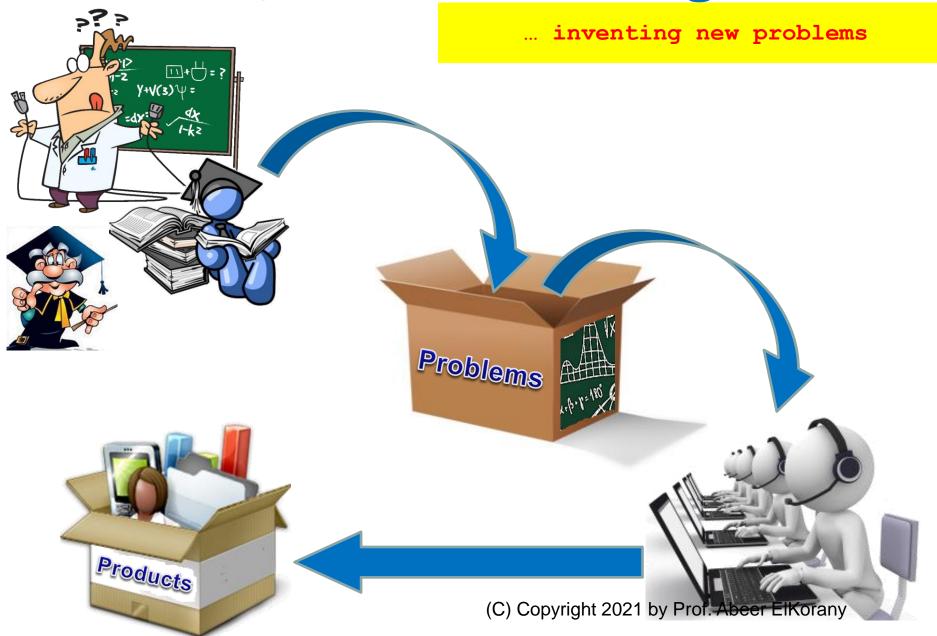… **installing (or API-based accessing as-a-service), administrating and using product as part of their professional activity or as a component in their applications or business processes … understanding WHAT the product is doing but without deep understanding HOW …**

Products

Good Engineers vs. **VIP Engineers**

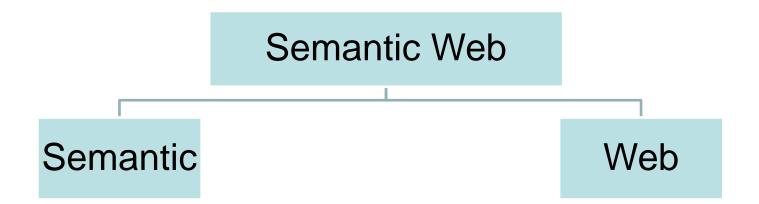… **inventing new problems**

Problems

Products

Overview of this lecture

- Introduction to Sematic Web
- Semantic Web standards
- Semantic Technology
- Semantic (Web) Applications and Service
- Relation to Big Data and Industry 4.0.

Semantic Computing

Phil Sheu in ICSC2007 cfp described it as:

"The field Semantic Computing applies technologies in natural language processing, data and knowledge engineering, software engineering, computer systems and networks, signal processing and pattern recognition, and any combination of the above to extract, access, transform and synthesize the semantics (contents) of multimedia, texts, services and structured data."

Semantic Web

Semantic

Web

What is the Semantic Web?

☐ Providing common machine-readable framework that allows data to be shared and reused across application, enterprise, and community boundaries

☐ Allowing machines to understand data
☐ Ease sharing and mixing data
☐ Extend the World Wide Web rather than replace it
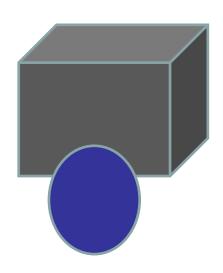
The Semantic Web is a web of data

What is the Semantic

Semantics is defined as that part of linguistics that deals with meaning
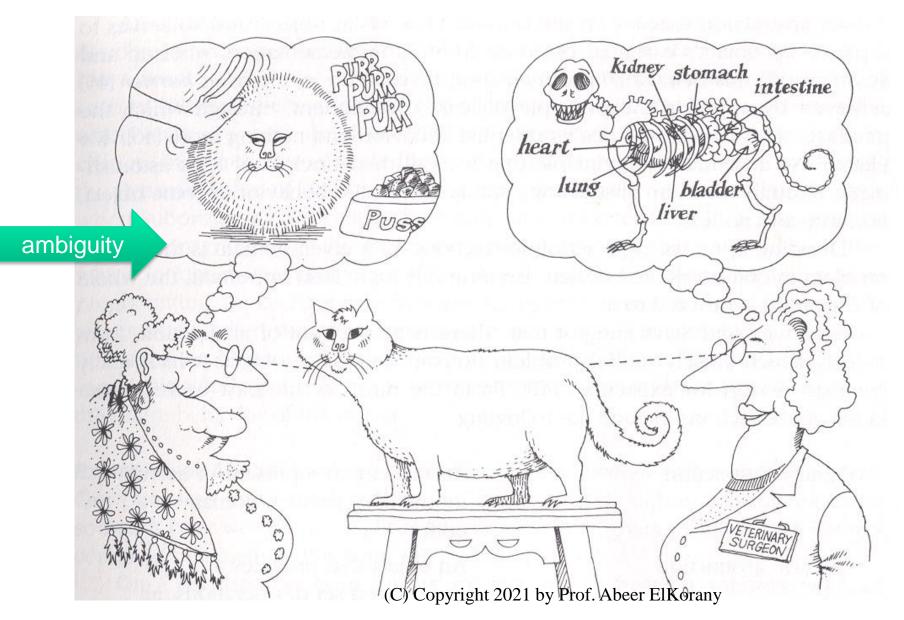! word meaning
! sentence meaning

Consider:
! The small blue circle is in front of the square.
! The square is behind the small blue circle.

Semantic is used for simplify communication between people

ambiguity

Semantics = meaning (from Greek)
What is understanding?

Relational understanding means a child knows what to do and can explain why.

IS IT TRUE?
IS IT HELPFUL?
IS IT INSPIRING?
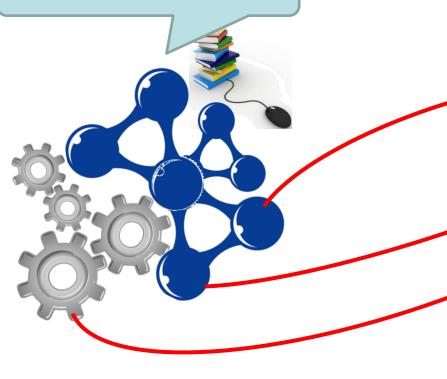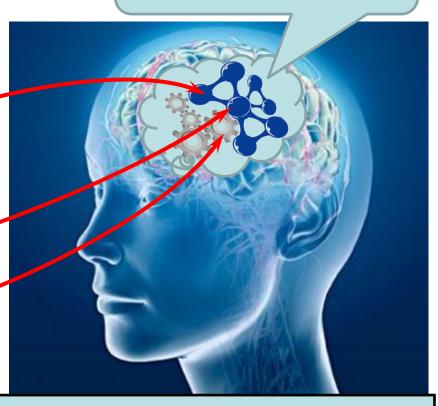IS IT NECESSARY?
IS IT KIND?

Instrumental understanding means a child knows a rule or procedure, and has the ability to use it.

Content understanding

Content to be learned

Own content: personal knowledge and skills
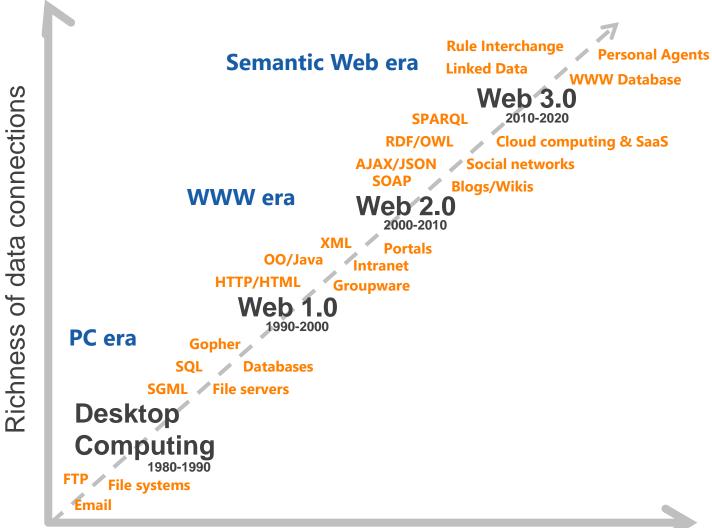
Understanding: the process of connecting (linking) the conceptual items of new knowledge and skills coming from external sources to the ones already stored as a personal knowledge and skills. Linked Data (emergent and challenging concept of Tim Berners Lee widely exploited by the Semantic Web community) is the good analogy and possible enabling technology for the content understanding.

What for semantics is?

Identification

Recognition

Evaluation

Decision making

Control

Thinking, reasoning, discovery

Handling huge information volumes

Communication

Utilization

Self-management

… a lot more!

Evolution of World Wide Web

Richness of data connections (y-axis)

Richness of social connections (x-axis)

Semantic Web era
- Rule Interchange
- Linked Data
- Personal Agents
- WWW Database

Web 3.0
2010-2020
- SPARQL
- RDF/OWL
- Cloud computing & SaaS
- AJAX/JSON
- Social networks
- SOAP
- Blogs/Wikis

WWW era

Web 2.0
2000-2010
- XML
- Portals
- OO/Java
- Intranet
- HTTP/HTML
- Groupware

Web 1.0
1990-2000

PC era
- Gopher
- SQL
- Databases
- SGML
- File servers

Desktop Computing
1980-1990
- FTP
- File systems
- Email
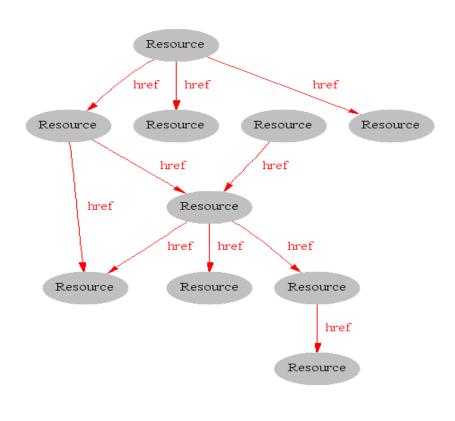
WWW: Basic Ideas

- Hypertext/hyperlink:
- Resource Identifiers
  - unique identifiers used to locate a particular resource (computer file, document or other resource) on the network
  - URI (Uniform Resource Identifier)/URL (Uniform Resource Locator): http or ftp
    - http://somehost/absolute/URI/with/absolute/path/to/resource.txt
    - ftp://somehost/resource.txt
- Markup language:
  - characters or codes embedded in text which indicate structure, semantic meaning, or advice on presentation
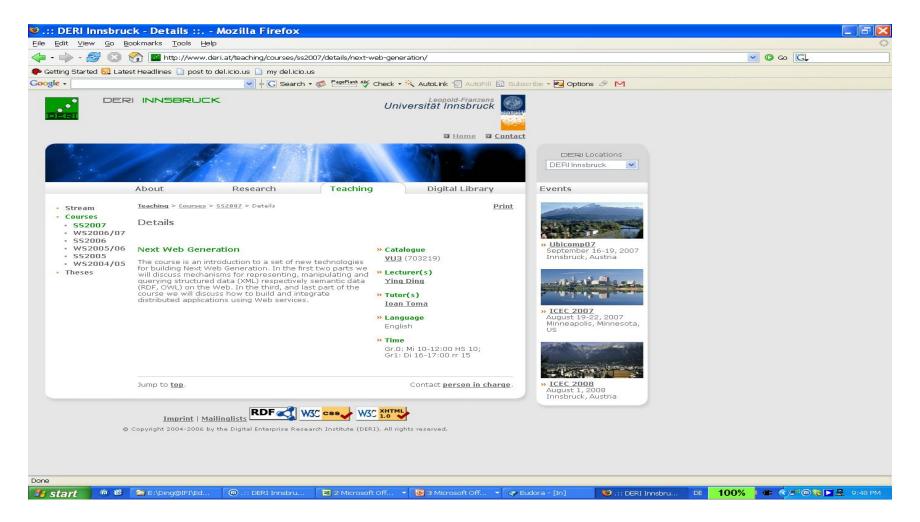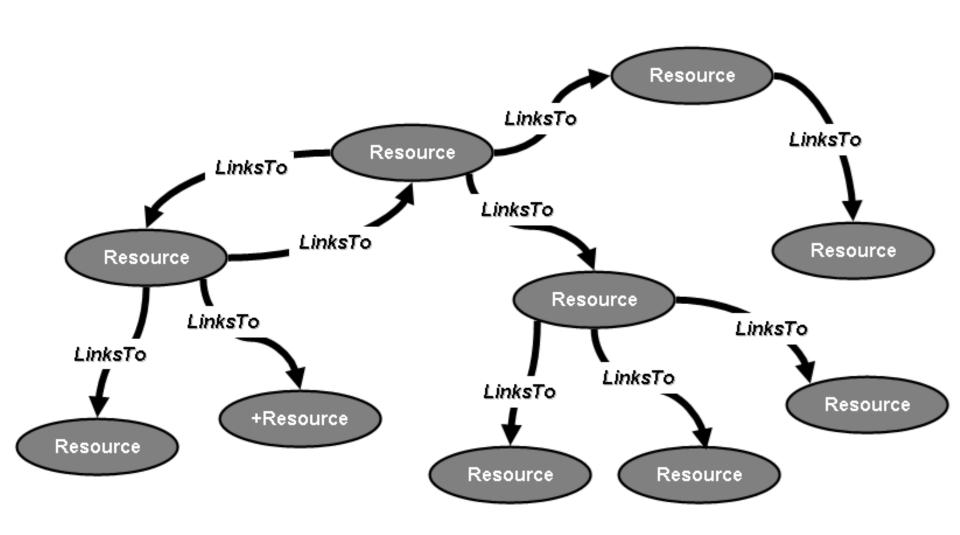
1- The Syntactic Web

[Hendler & Miller 02]

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WWW – Web 1.0

Most of the Current Web (dumb links)

Social Web – Web 2.0

- http://en.wikipedia.org/wiki/Web_2.0
  - *"Web 2.0 … has … come to refer to what some people describe as a second phase of architecture and application development for the World Wide Web."*
- The Web where "ordinary" users can meet, collaborate, and share using **social software** applications on the Web (tagged content, social bookmarking, AJAX, etc.)
- Popular examples include:
  - Linkedin, del.icio.us, digg, Flickr, Google Maps, Skype, Wikipedia…

Features / principles of Web 2.0

1. The Web as platform
2. Harnessing collective intelligence
3. Data is the next "Intel Inside"
4. End of the software release cycle
5. Lightweight programming models
6. Software above the level of a single device
7. Rich user experiences

This fact leads to a key question: Who owns the data

Cheaper

WEB 2.0

More Open

More Social

DSCF0831

Uploaded on July 23, 2005
by **Cloudie**

Cloudie's photostream

180 photos
View as slideshow

◄more   browse   more►

This photo also belongs to:

2005_0721Yosemite (Set)

28 photos
View as slideshow

◄more   browse   more►

yosemite (Pool)

Tags

yosemite

Additional Information

© All rights reserved

○ Taken with a Fujifilm FinePix A210.
   More properties
○ Taken on July 21, 2005
○ Viewed **228** times

This photo is **public**

Comments

mtnjohn pro says:

Great capture.
Posted 18 months ago. (permalink)

Cloudie pro says:
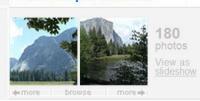
Thanks!
Posted 18 months ago. (permalink)

Campin' Guy pro says:

Nice shot! I see a lot of Yosemite picture and I can honestly say, "THIS is a nice

Done   Internet   150%

logged in as **Cloudie** | settings | logout | help

» del.icio.us history for | http://sioc-project.org/ | check url | | del.icio.us ▼ | search

sioc-project.org | Semantically-Interlinked Online Communities

http://sioc-project.org/

this url has been saved by 93 people.

SIOC Project edit / delete
Semantically-Interlinked Online Communities
by Cloudie to sioc semanticweb distributedconversations rdf
unifiedcommunities virtualforums blogs forums mailinglists
users ... on oct 04

user notes

Jan '07

SIOC provides methods for interconnecting discussion methods
such as blogs, forums and mailing lists to each other. It consists
of the SIOC ontology, an open-standard machine readable format
for expressing the information contained both explicitly and imp
  - fhasi897

Oh, and here's some of my original idea for sparrow, which was
just an end-run around the whole semantic web bullshit. These
guys seem to be wallowing in the semantic web bullshit, though
  - fweez

Dec '06

common tags   cloud | list

blog   blogging   blogs   communities   community   deri
design   foaf   metadata   networks   ontologies   **ontology**

owl   project   rdf   research   semantic   **semanticweb**

semweb   **sioc**   social   socialnetworking   socialsoftware

toread   web

related items - show ↓

posting history

» first posted by Wikier to sioc

Jan '07

by fhasi897 to ontology owl semanticweb

by agharbeia to metadata semanticweb sioc
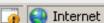
by Kashirin_Victor to semantic

by glacial23 to socialsoftware
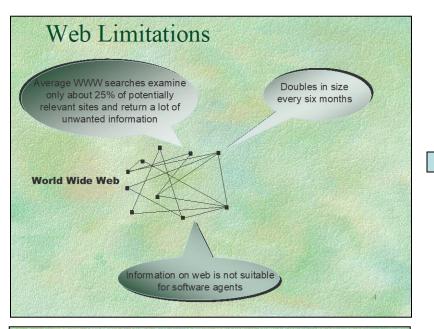
by fweez to web semantic social bullshit

by Cristie79 to semantic web

Internet   100%
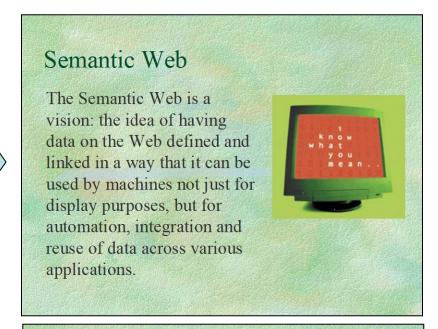
Motivation for Semantic Web

Web Limitations

Average WWW searches examine only about 25% of potentially relevant sites and return a lot of unwanted information

Doubles in size every six months

World Wide Web

Information on web is not suitable for software agents

4

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.

i know what you mean..

Before Semantic Web

WWW and Beyond

Creators

Web content

Users

Semantic Web Structure

Semantic Web

Semantic Annotations

Ontologies

Logical Support

Languages

Tools

Applications / Services

WWW and Beyond

Creators

Web content

Users
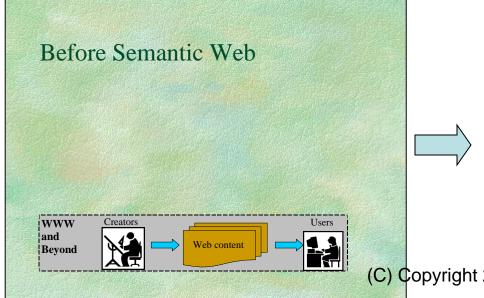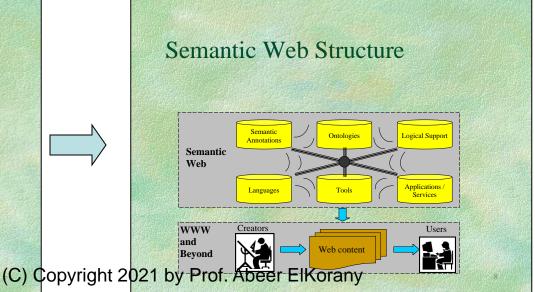
8

What is the Semantic Web?

- Web was "invented" by **Tim Berners-Lee** (amongst others), a physicist working at CERN (European Organization for Nuclear Research)
- His vision of the Web was much more ambitious than the reality of the existing (syntactic) Web:

"… a set of **connected applications** … forming a **consistent logical web of data** …"

"… an extension of the current web in which information is given **well-defined meaning**, better enabling computers and people to work in cooperation …"

Web of machine-readable data

Approach: 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"

W3C®   http://www.w3.org/sw/
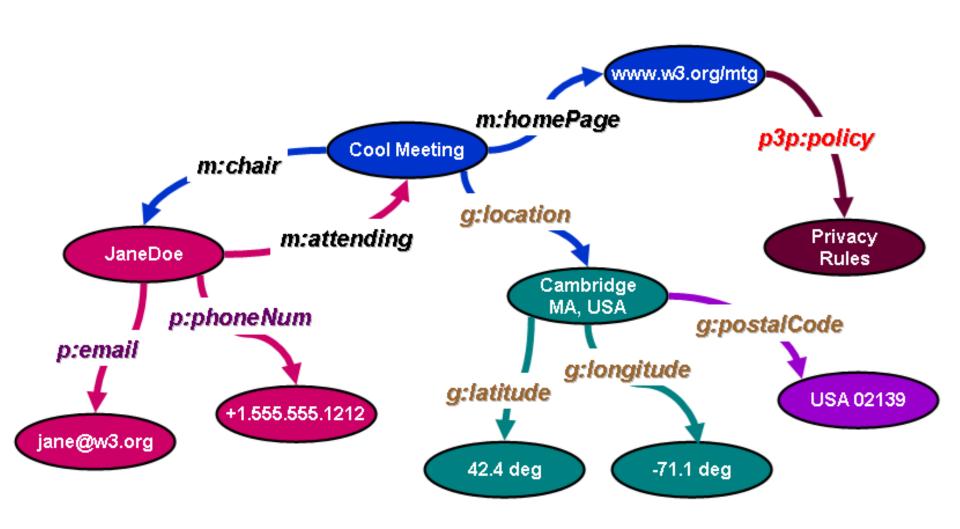
The Semantic Web is an initiative with the goal of extending the current Web and facilitating Web automation, universally accessible web resources, and the 'Web of Trust', providing a universally accessible platform that allows data to be shared and processed by automated tools as well as by people.

Semantic Web

(data connected by relationships)

Tim Berners-Lee's Vision of Semantic Web (IJCAI-01)

Semantic Web Stack
(updated, W3C, 2006)

User Interface & applications

Trust

Proof

Unifying Logic

Query: SPARQL

ontology: OWL

Rules: RIF

RDF-S

Crypto

Data interchange: RDF

XML

URI

Unicode
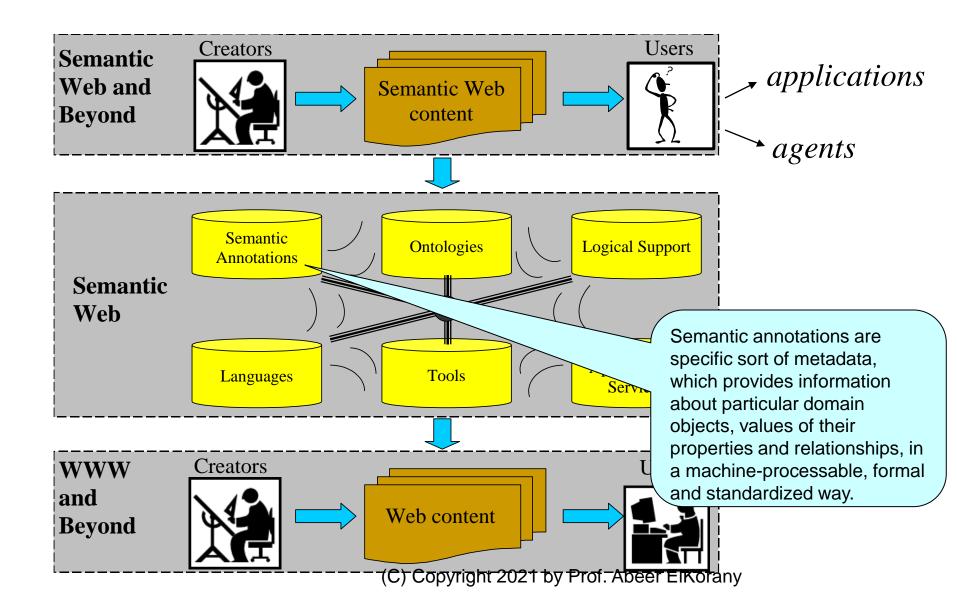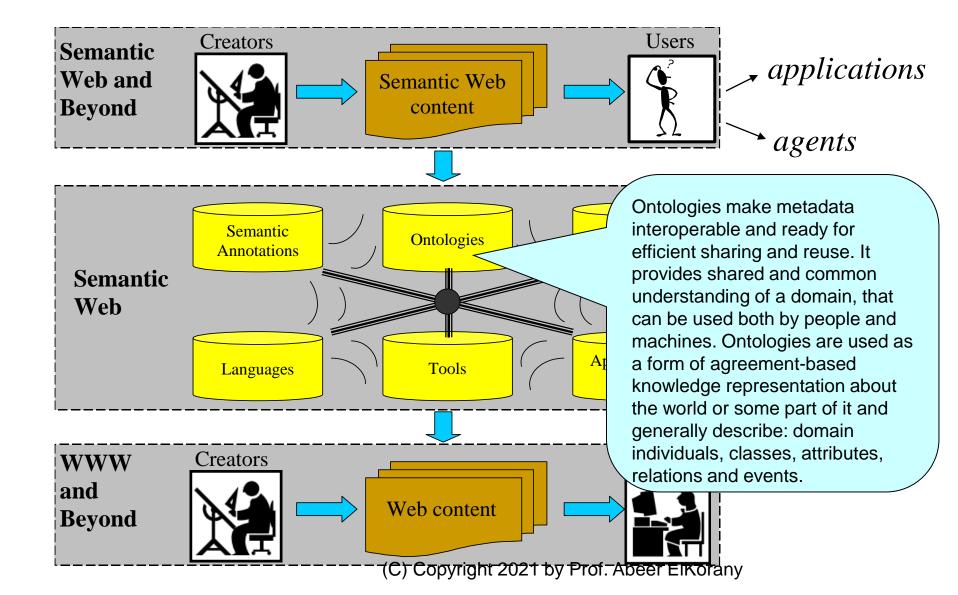
Semantic Web: New "Users"

Semantic Web and Beyond

Creators → Semantic Web content → Users → applications, agents

Semantic Web

Semantic Annotations, Ontologies, Logical Support, Languages, Tools, Applications / Services

WWW and Beyond

Creators → Web content → Users
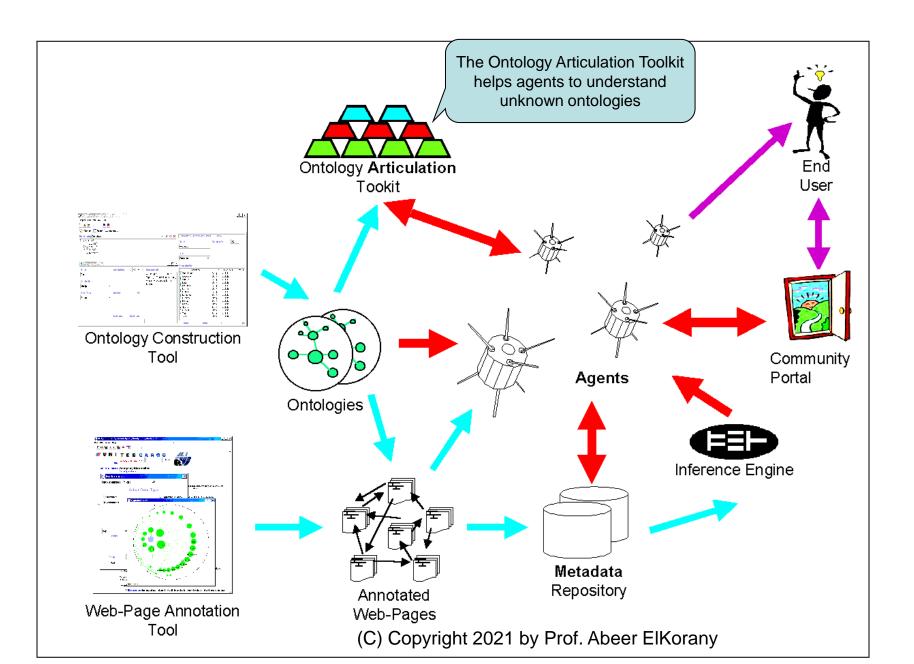
Semantic Web: Annotations

Semantic Web and Beyond

Creators → Semantic Web content → Users → *applications*, *agents*

Semantic Web

Semantic Annotations | Ontologies | Logical Support
Languages | Tools | Services

Semantic annotations are specific sort of metadata, which provides information about particular domain objects, values of their properties and relationships, in a machine-processable, formal and standardized way.

WWW and Beyond

Creators → Web content → Users

Semantic Web: Ontologies

Semantic Web and Beyond

Creators

Semantic Web content

Users

applications

agents

Semantic Web

Semantic Annotations

Ontologies

Languages

Tools

Ap...

Ontologies make metadata interoperable and ready for efficient sharing and reuse. It provides shared and common understanding of a domain, that can be used both by people and machines. Ontologies are used as a form of agreement-based knowledge representation about the world or some part of it and generally describe: domain individuals, classes, attributes, relations and events.

WWW and Beyond

Creators

Web content

The Semantic Web

The Ontology Articulation Toolkit helps agents to understand unknown ontologies

Ontology **Articulation** Tookit

Ontology Construction Tool

Ontologies

Web-Page Annotation Tool

Annotated Web-Pages

Metadata Repository

Agents

Inference Engine

Community Portal

End User

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Semantic Web: Added Value

Web 1.0 — Producer → document → Consumer

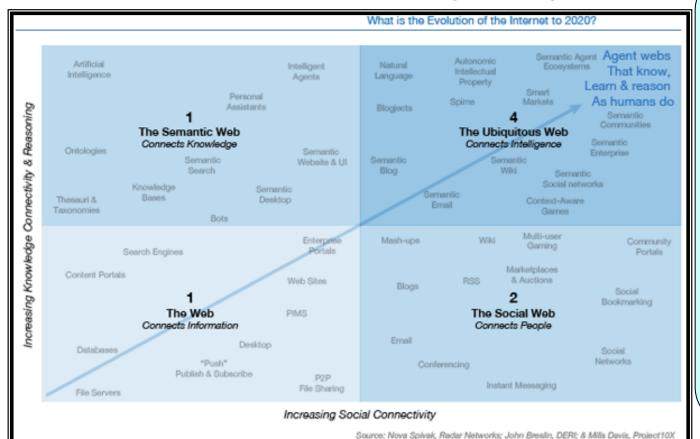Web 2.0 — C/P = Consumer/Producer

The Semantic Web

What is the Semantic Web?

– *"An extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation."*

   • Sir Tim Berners-Lee et al., Scientific American, 2001: tinyurl.com/i59p

– *"…allowing the Web to reach its full potential…"* with far-reaching consequences

– *"The next generation of the Web"*

What is Semantic Web for?

- Integrating - trying to solve the problem of data and service integration

- Searching - Providing better communication between human and computers by adding machine-processable semantics to data.

"Semantic Wave" (Web X.0)

What is the Evolution of the Internet to 2020?

Source: Nova Spivak, Radar Networks; John Breslin, DERI; & Mills Davis, Project10X

We may add here:

Web 5.0 will come finally and it is about **connecting models** in a "**Global Understanding Environment**" **(GUN),** which will be such proactive, self-managed evolutionary Semantic Web of Things, People and Abstractions where all kinds of entities can understand, interact, serve, develop and learn from each other.

[Vagan Terziyan]

"The **semantic wave** embraces four stages of internet growth:

Web 1.0, was about **connecting information** ...

Web 2.0 is about **connecting people**.

Web 3.0, is starting now… and it is about … **connecting knowledge**…

Web 4.0 will come later … and it is about **connecting intelligences** in a ubiquitous web where both people and things can reason and communicate together."

["**Semantic Wave 2008**" , **Mills Davis**]   (C) Copyright 2021 by Prof. Abeer ElKorany

Beyond Web 5.0 ?
Human v2.0 !
(?)

Brain-Machine Interfaces

https://www.youtube.com/watch?v=q-fE9QBy0FI

Brain-to-Brain Interfaces

https://www.youtube.com/watch?v=8ly9C5UOgIU

Nanobots

https://www.youtube.com/watch?v=UX_GdUCp3YM

2029
Singularity

Semantic Wave

Nanotech

https://www.youtube.com/watch?v=BNbK1e0wqEA
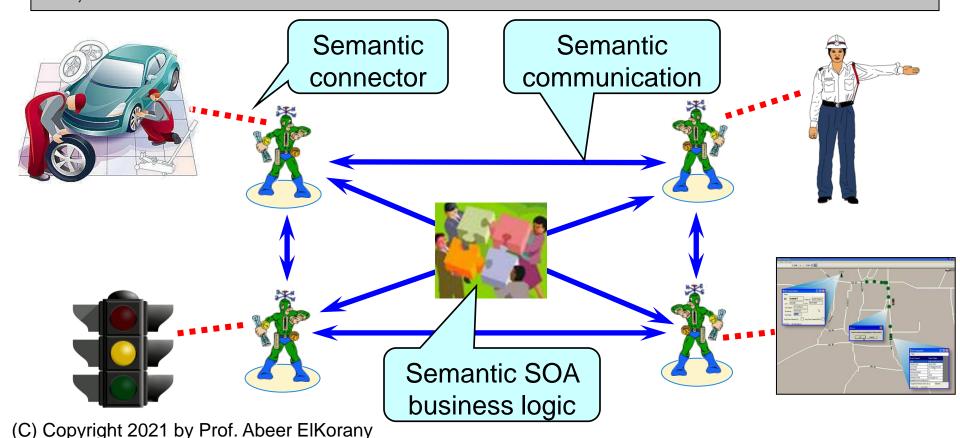
https://www.youtube.com/watch?v=fXB5-iwNah0

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Agents are needed !
… and semantics is needed !

Adding a **"virtual representative"** to every resource solves the global interoperability problem. Intelligent **agent** (a kind of "software robot") will act, communicate and collaborate on behalf of each Web resource

Semantic connector

Semantic communication

Semantic SOA business logic

What are the main aims of the SW?

– Automated query-answering
– Automated use of the data (reasoning, planning, acting, etc.)

• Why the Semantic Web?

– Syntax / semantics distinction:
– philosophy of language, linguistics, formal logic
– Syntax concerned with arrangement of symbols
– Semantics concerned with the relation between symbols strings and the world: what things actually mean