



# The Semantic Web

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CSCI 7818: Web Technologies

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November 7, 2001



# Credit where Credit is Due

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- Most of the information for this presentation comes straight from
- <http://www.w3.org/sw/>
- This is the Web Consortium's website for coordinating the Semantic Web Activity



# High-Level Example

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- Pete and Lucy have an elderly parent that needs to see a physical therapist and, despite having busy schedules, they need to share chauffeuring responsibilities
- Lucy instructs her Semantic Web agent through her handheld Web browser to do this following...



## High-Level Example, continued

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- Retrieve information about her mom's *prescribed treatment* from the doctor's agent, look up several lists of *providers*, check for ones *in-plan* for mom's insurance within a *20-mile radius* of her *home* and with a rating of *excellent* or *very good* on trusted rating services.
- The agent then began trying to find a match between available *appointment times* and Pete and Lucy's schedules
- Terms in italics are have semantics defined by the Semantic Web



## Example, continued

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- This example is taken from the Semantic Web article that appeared in Scientific American.
- The example provides additional details of the first schedule not working to Pete's taste (the hospital was too far away and the appointment fell during rush hour) and so his agent re-ran the search using stricter preferences about location and time
- His agent was able to access the information already found by Lucy's agent because Lucy specified *complete trust* in Pete



# Discussion of Example

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- The example demonstrates
  - a vision for the semantic web
    - lots of metadata, lots of terms with defined meanings
    - complex searches and tasks being supported by such information
    - notion of trust
      - Pete and Lucy can share information
      - They look for providers rated “excellent” by a rating system that they trust



# Extension of Knowledge Management

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- The Semantic Web is an attempt at knowledge representation on the web
- It will provide structured collections of information and sets of inference rules that can be used to conduct automated reasoning
  - These sets will be decentralized and consistency will not be a (major) concern
    - Much as “dangling links” are today with the Web

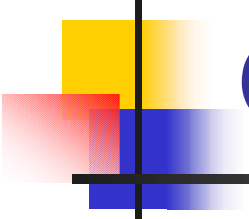


# Knowledge Building Blocks

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- XML and RDF
  - XML provides a standard encoding format with a large set of associated tools
  - RDF, also an XML format, expresses meaning
    - It uses sets of triples, with each triple being similar to the subject, verb, and object of an elementary sentence
    - They assert that things have properties with certain values (Subject and Object are specified with URIs)
    - Verbs are also defined by URIs which allows anyone on the web to come up with a new verb, just by defining a URI for it somewhere on the Web





# Building Blocks Create Ontologies

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- Ontologies are collections of information; in particular they are documents which describe relationships between terms
- Semantic Web ontologies each provide a taxonomy and a set of inference rules



# Example

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- Taxonomy
  - An address is a type of location
  - City codes can only be applied to locations
- Taxonomy's specify classes, subclasses, and relationships between terms
- Inference rules
  - If a city code is associated with a state code, and an address uses that city code, then that address has the associated state code
- A program can then readily deduce that a Cornell University address being in Ithaca must also be in New York State



# Benefits of Ontologies

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- The ability to perform better searches
  - If I ask the question “Where did Ken Anderson get his Ph.D.?”, it may be difficult to provide an answer (even by searching my web page)
  - But with an appropriate ontology, such a search may be readily possible (of course, it requires me to create some metadata)

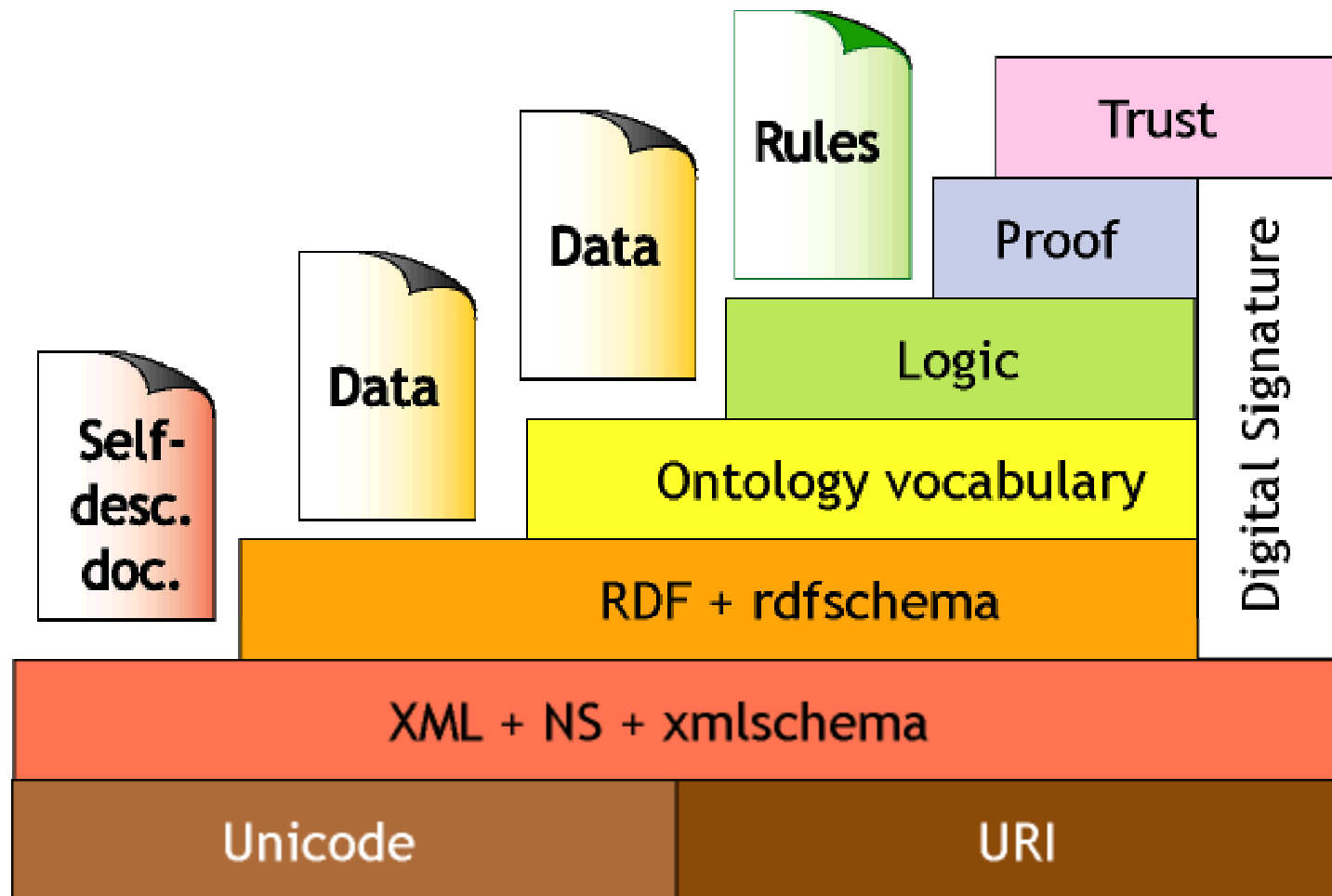


# Agents

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- The real power of the semantic web will be realized when agents are created that can search for and share information with other agents
  - Agents will be able to provide “proofs” as to how it came up with its answers
    - e.g. for any query, it will be possible to express how ontologies were used to come up with the answer
  - Agents can operate in a “web of trust” with rating systems and digital signatures
  - The power of web services can be increased since agents can query a service for its ontology and see if the service provides a capability it understands
- A DARPA-funded project is already looking at Agent Markup Languages for specifying agent capabilities

# Proposed Architecture





# Semantic Web: One Step at a Time

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- Data identification and retrieval:
  - Enables applications to gather data from different domains without "screen scraping".
- Organic development of vocabularies:
  - Ontologies may be developed by anyone.
  - Information providers decide which vocabularies to use.
  - Likely scenario:
    - One or more data providers in a domain use their expertise to develop an ontology.
    - They write and publish a schema for use by others.
    - Many data providers choose to use this schema (it wins the popularity contest).
- Model constraints:
  - Enable machine-enforced type checking.
  - Enable type inferencing.
    - If it has a `personel:HealthCarePackage` it must be a `personel:Person`.
- Assertions and proofs:
  - Enable agents to accept data (from multiple sources) and "make decisions".
    - I am an employee of MemberCo.
    - MemberCo is a member of W3C.
    - I (therefore) have access to <http://www.w3.org/Member/>.



# Semantic Web Future

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- Logic
  - I am an employee of MemberCo.
  - MemberCo is a member of W3C.
  - MemberCo has GET access to <http://www.w3.org/Member/>.
  - I (therefore) have access to <http://www.w3.org/Member/>.
- Proof
  - MemberCo's document employList lists me as an employee.
  - W3C's member list includes MemberCo.
  - The ACLs for <http://www.w3.org/Member/> assert that employees of members have GET access.
- Trust
  - MemberCo's document employList is signed by a private key that W3C trusts to make such assertions.
  - W3C's member list is trusted by the access control mechanism.
  - The ACLs for <http://www.w3.org/Member/> were set by an agent trusted by the access control mechanism.
- Making the simple stuff simple and the complex stuff possible.



# Next Steps

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- Taking the Semantic Web to the Physical World
  - Home Automation
    - Network Appliances can describe their services via ontologies, web agents can then control aspects of your house both locally and remotely (e.g. “Oh, we forgot to turn the water heater down before we left for vacation; don’t worry, we’ll have our web agent turn it down for us!”)
    - There is already work in this area: Composite Capability/Preference Profile => initially for cell phones





# Concluding Remarks

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- For more information...
  - <http://www.w3.org/Talks/2001/07/30-swws/>
- For next week
  - DAML (DARPA Agent Markup Language)
    - <http://www.daml.org/>
  - Ontologies
    - <http://www.semanticweb.org/knowmarkup.html>
  - RDF Schema
    - <http://www.w3.org/TR/rdf-schema/>