The Vision

In the first part, the Web becomes a much more powerful means for collaboration between people. […]

In the second part of the dream, collaborations extend to computers. Machines become capable of analyzing all the data on the Web - the content, links, and transactions between people and computers. A "Semantic Web," which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy, and our daily lives will be handled by machines talking to machines, leaving humans to provide the inspiration and intuition. The intelligent "agents" people have touted for ages will finally materialize. This machine-understandable Web will come about through the implementation of a series of technical advancements and social agreements that are now beginning (and which I describe in the next chapter).

Weaving the Web, Tim Berners-Lee, 2000

The Example

The Issues

- Knowledge representation
- Intelligent agent

The Stack (2000 version)
The Stack (2003 version)

The Stack (2005 version)

Resource Description Framework (RDF)

A language that describes resources, which essentially can be anything.

RDF triple: <subject, predicate, object>

RDF Example 1

Kobe Bryant plays for the Lakers. The official web site of the Lakers is http://www.nba.com/lakers.


subject predicate literal object

RDF Example 2

Name  | Sport   | Location
-----|---------|---------
Lakers| Basketball| Los Angeles
Yankees| Baseball| New York

@prefix nba: <http://www.nba.com/ontology> @prefix mlb: <http://www.mlb.com/ontology> @prefix general: <http://www.w3.org/ontology>
<nba:lakers> <general:sport> <general:baseball>
<nba:lakers> <general:location> <general:la>
<mlb:yankees> <general:sport> <general:baseball>
<mlb:yankees> <general:location> <general:ny>

Merge and Reasoning

bryant  
lakers  
basketball
http://www.nba.com/lakers

la
Other Features

- **Containers**
  - Bag, sequence, alternate
  - Statements can be made about either a collection or an individual element of the collection
- **Reification** – making statements about statements
  - Statement as subject

RDF/XML Serialization

```xml
<rdf:RDF xmlns:nba="http://www.nba.com/ontology#"
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <rdf:Description rdf:about="http://www.nba.com/ontology#Bryant">
    <nba:plays-for>
      <rdf:Description rdf:about='http://www.nba.com/ontology#Lakers">
      </rdf:Description>
    </nba:plays-for>
  </rdf:Description>
</rdf:RDF>
```

RDF Adoption

- The Semantic Web, Decker et. al, 2003

Ontology

- Description, representation, and classification concepts and their relationships
- Vocabulary, taxonomy, thesaurus, database schema, UML diagram, logic ...

Dublin Core Metadata Initiative

- [http://dublincore.org/](http://dublincore.org/)

Open Directory Project

- [http://dmoz.org/](http://dmoz.org/)
So How to We Define an Ontology?

- RDF Schema
- OWL

RDF Schema
- `rdfs:Class`
- `rdfs:label`
- `rdfs:subclassOf`
- `rdfs:Property`
- `Rdfs:subPropertyof`
- `rdfs:domain`
- `rdfs:range`
- `rdfs:type`
- `rdfs:seeAlso`
- `rdfs:isDefinedBy`
- `rdfs:comment`
- `rdfs:Literal`
- `rdfs:XMLLiteral`

RDF Schema Example

The Semantic Web, Deconta et. al, 2003

OWL

- Web Ontology Language (OWL)
  - OWL Full
  - OWL DL
  - OWL Lite

Some OWL Elements
- `owl:AllDifferent`
- `owl:Class`
- `owl:DataRange`
- `owl:DatatypeProperty`
- `owl:DeprecatedClass`
- `owl:DeprecatedProperty`
- `owl:FunctionalProperty`
- `owl:InverseFunctionalProperty`
- `owl:Nothing`
- `owl:ObjectProperty`
- `owl:Ontology`
- `owl:Restriction`
- `owl:SymmetricProperty`
- `owl:maxCardinality`
- `owl:minCardinality`
- `owl:oneOf`
- `owl:property`
- `owl:priorVersion`
- `owl:sameAs`
- `owl:sameIndividualAs`
- `owl:someValuesFrom`
- `owl:subClassOf`
- `owl:TransitiveProperty`
- `owl:unionOf`
- `owl:versionInfo`
References

- Various presentations by Tim Berners-Lee -
  [http://www.w3.org/People/Berners-Lee/](http://www.w3.org/People/Berners-Lee/)

The Other Side of the Story

I'd rather make progress by having computers understand what humans write, than by forcing humans to write in ways that computers can understand.

Sergey Brin at *InfoWorld 2002 CTO Forum*