The real power of the Web?

- To be distributed
- → its potential is all about ***aggregation*** of informative resources

Massachusetts
Institute of
Technology

The Babel Tower of the Web...

- "Send a rose to my girlfriend"

Babel Tower…

- <html>

  …

  Box of Roses …

  price: 15 dollars

  …

Babel Tower...

- <HTML>...
  From editor The Dark Rose...
  ... price 7.50 dollars, the book "The Art of Masochism"...(!!)

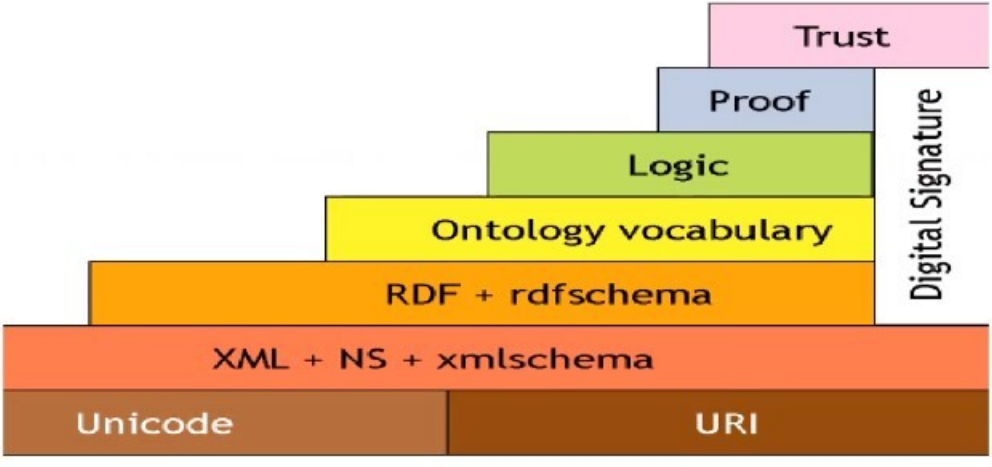
The Semantic Web

- Tries to facilitate automatic aggregation of information…
- … and even more, try to enable ***automatic reasoning*** on such information

How?

- Adding… "semantics" (meaning) in the appropriate way, so to enable information understanding and reuse

The Semantic Web Tower ("classic" version)



Base technology: RDF

- **R**esource **D**escription **F**ramework: Framework to describe resources
- The milestone of the "Web2": a universal language to express information on the web and beyond
- It describes relationships and concepts

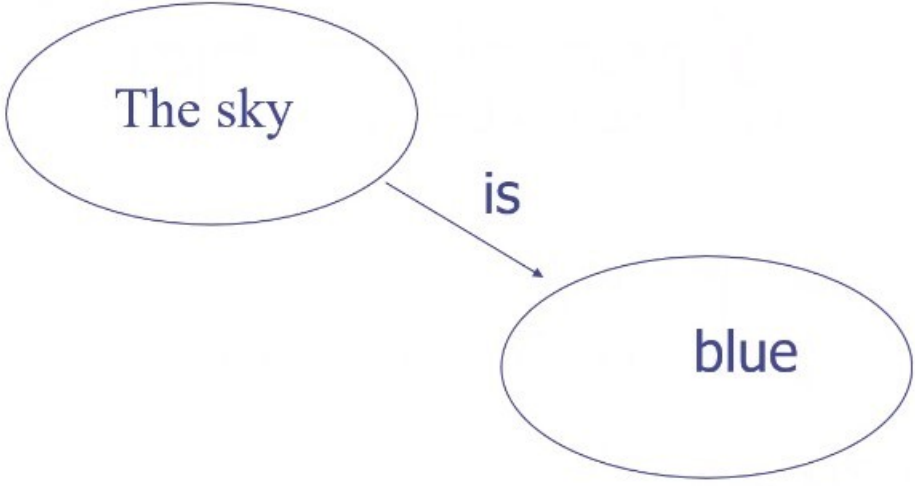
The RDF model

- Technically, an "enriched entity-relationship" knowledge model
- Base grammar:
- A "sentence" is made by:
- **subject predicate object**

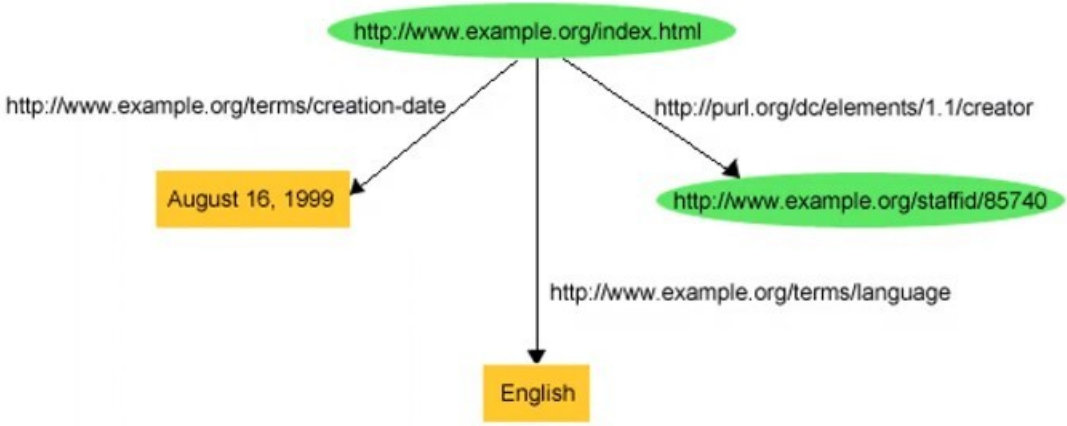
The RDF model

- Essentially, this is the backbone of RDF..
- With more power ("enriched"): referencing, quoting, bags etc etc

RDF as a **graph**



RDF as graph...


http://www.example.org/index.html
http://www.example.org/terms/creation-date
http://purl.org/dc/elements/1.1/creator
August 16, 1999
http://www.example.org/staffid/85740
http://www.example.org/terms/language
English

Writing RDF?

- Many possibilities! Remember RDF is a model, that can then be written in various ways!
- Two most used ways:
- As XML (specific dialect)
- As N-triples

As XML...

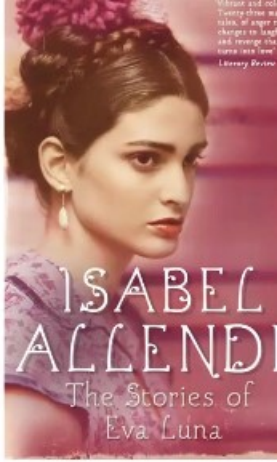
- <rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:exterms="http://www.example.org/terms">
  <rdf:Description
  rdf:about="http://www.example.org/index.html">
  <exterms:creation-date>August 16, 1999
  </exterms:creation-date> </rdf:Description>
  <rdf:Description
  rdf:about="http://www.example.org/index.html">
  <exterms:language>English</exterms:language>
  </rdf:Description>
  </rdf:RDF>

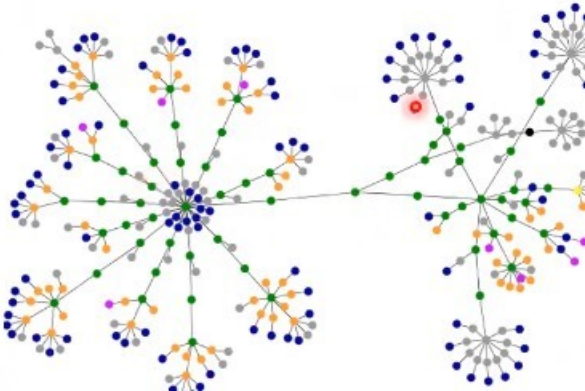
RDF and aggregation

- RDF enables easy aggregation of information sources
- Because essentially, merging graphs (a forest) gives again graphs
- The graphs doesn't always stay distinct, but they can melt together…

Melting? How?

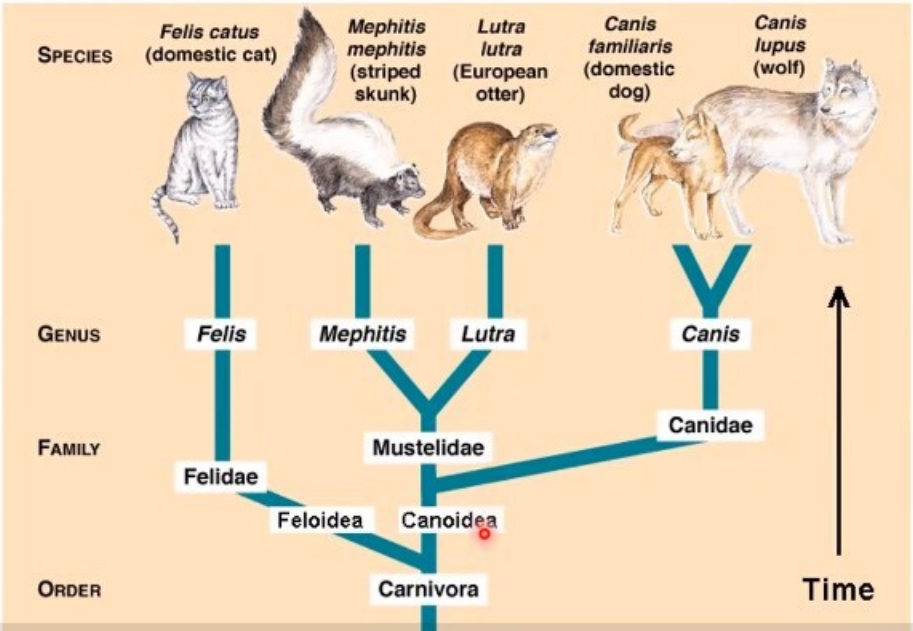
- Via URLs (URIs), the names of the web!





What do we want as a minimum?

- To ***classify*** information



Ontologies

- Systems for information classification
- Information of "type X", where here "type" is a ***semantic type***

Types

- Classic "type" in computer science: the datatype
- Examples: integers, strings, URIs etc
- They give information on the ***syntactic format*** of the object

Types (cont.)

- Semantic type → they provide the meaning of the objects

Examples

- P2P (Peer to Peer): e.g., Kazaa, Bearshare, Gnutella
- MP3 songs exchange
- **RIIA** (Recording Industry Association of America)…

#Usher #Yeah #LilJon

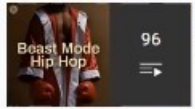
Usher - Yeah! (Official Video) ft. Lil Jon, Ludacris

615,526,043 views • Apr 17, 2015

4M DISLIKE SHARE SAVE ...

Usher - Love in This Club (Official Music Video) ft. Youn...
Usher
186M views • 12 years ago

Mix - Usher - Yeah! (Official Video) ft. Lil Jon, Ludacris
YouTube



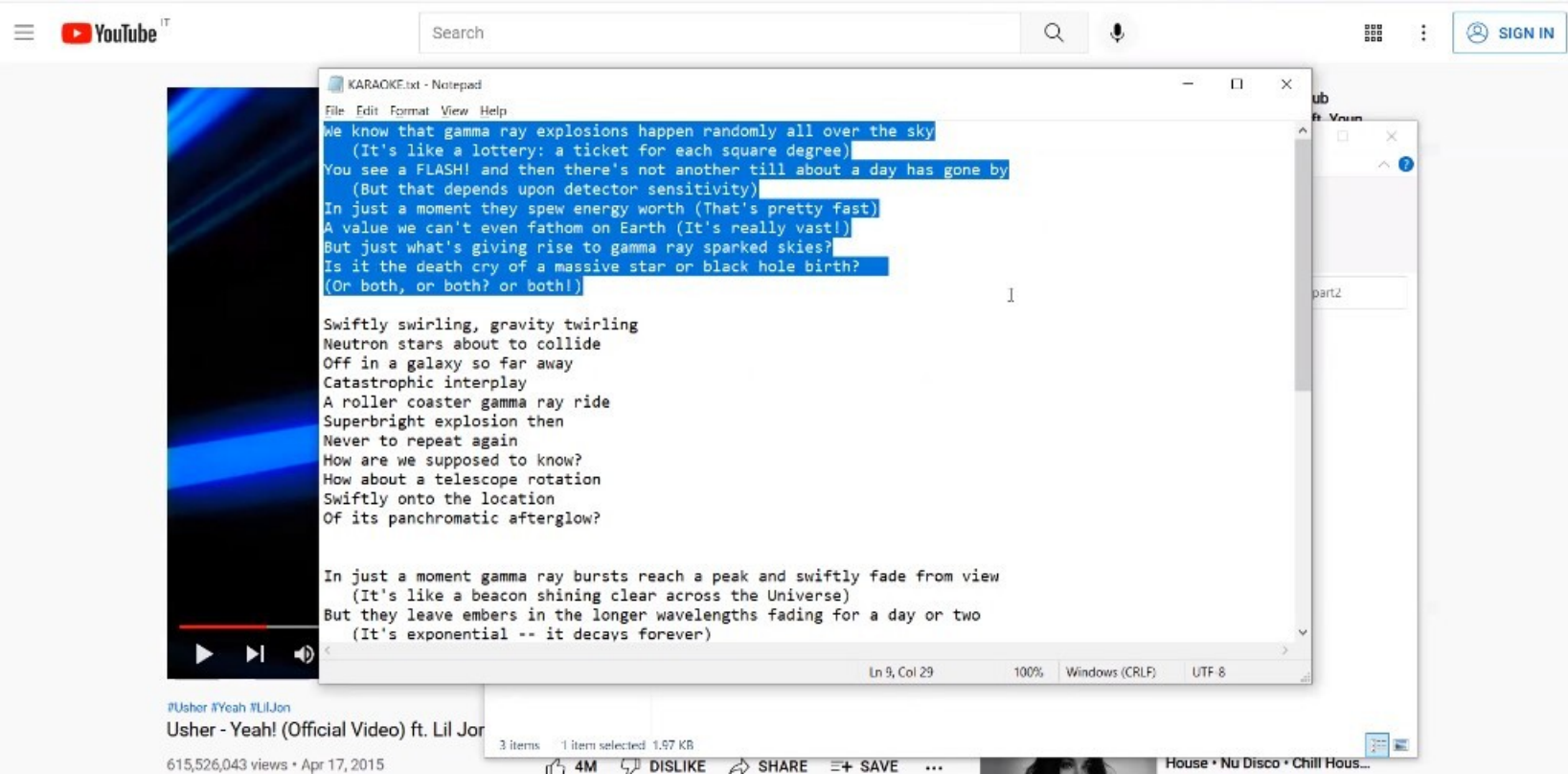
Beast Mode Hip Hop
YouTube Music
Updated today

Akon - Smack That (Official Music Video) ft. Eminem
Akon - Smack That (Official Music Video) ft. Eminem
Akon
829M views • 11 years ago

PITBULL - HIP HOP 2021 - Greatest Hits - New Album...
Happy Songs Playlist
2M views • 5 months ago

Best Romantic Songs Ed Sheeran, Lady Gaga, Maroon 5...
Happy Songs Playlist
3.1M views • 1 month ago

Deep Emotions 2021 | Deep House • Nu Disco • Chill Hous...
Black MixTape


YouTube
Search
SIGN IN
KARAOKE.txt - Notepad
File Edit Format View Help
We know that gamma ray explosions happen randomly all over the sky
(It's like a lottery: a ticket for each square degree)
You see a FLASH! and then there's not another till about a day has gone by
(But that depends upon detector sensitivity)
In just a moment they spew energy worth (That's pretty fast)
A value we can't even fathom on Earth (It's really vast!)
But just what's giving rise to gamma ray sparked skies?
Is it the death cry of a massive star or black hole birth?
(Or both, or both? or both!)
Swiftly swirling, gravity twirling
Neutron stars about to collide
Off in a galaxy so far away
Catastrophic interplay
A roller coaster gamma ray ride
Superbright explosion then
Never to repeat again
How are we supposed to know?
How about a telescope rotation
Swiftly onto the location
Of its panchromatic afterglow?
In just a moment gamma ray bursts reach a peak and swiftly fade from view
(It's like a beacon shining clear across the Universe)
But they leave embers in the longer wavelengths fading for a day or two
(It's exponential -- it decays forever)
Ln 9, Col 29
100%
Windows (CRLF)
UTF-8
#Usher #Yeah #LilJon
Usher - Yeah! (Official Video) ft. Lil Jon
615,526,043 views • Apr 17, 2015
4M
DISLIKE
SHARE
SAVE
3 items
1 item selected 1.97 KB
House • Nu Disco • Chill Hous...

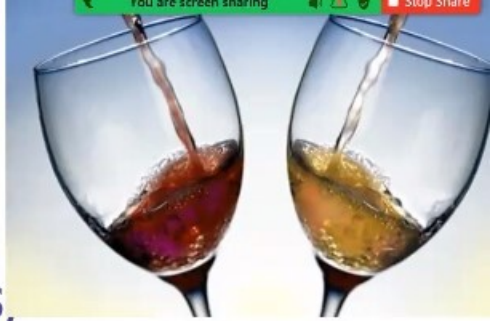
So…

- Syntactic type (datatype):
- "Usher" is of ***string*** type
- Semantic type:
- "Usher" is a ***singer*** type

The semantic types...

- ... are more commonly called ***classes***
- So, an ***ontology*** is basically composed by a ***collection of classes***. Each classe can contain objects, and so these objects ***belong*** to a class

Example



- Wine ontology:
- Red wines, white wines, pink wines, Merlot, Cabernet, Chardonnay etc…
- The class "red wines" can contain the objects "Merlot bottle from 1999", "Cabernet bottle" and so on.

Structure

- The interesting thing is that an ontology can also have an internal structure (so, not just being a "flat" collection of classes)
- The easiest structure is the so-called ***hierarchical structure***
- → a class can be contained in another class, and so on

So...

- In general, the hierarchical structure is provided by a ***containment*** relationship among classes, that can be true or false

More structure = more power

- For instance, we can now perform information ***integrity check***, and also ***deductions*** (reasoning)

How do we support ontologies in the Semantic Web?

- Via **RDF Schema**: the standard the enriches RDF with the basic support for ontologies management

RDF-Schema (cont.)

- rdf:Property
- rdfs:subPropertyOf
- rdfs:domain

Example

- "eat" can be defined as a property
- Subproperty of the "act" property
- With domain "animals"
- And with range "food"

So…

- With RDF Schema we can enrich information with categorizations, providing semantic types and relationships

Tim Berners-Lee...

- ... and the axioms of Web Architecture

Axiom 0: Universality 1

- Any resource anywhere can be given a URI

Axiom 0a: Universality 2

- Any resource of significance should be given a URI

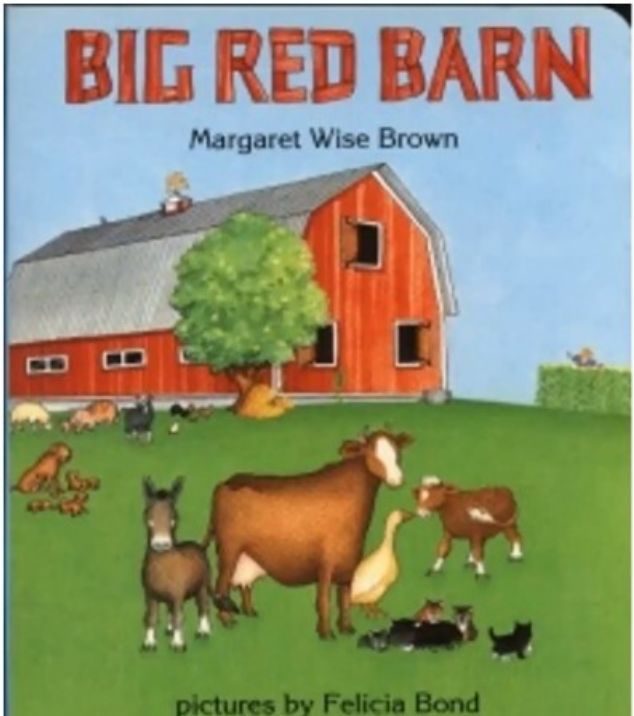
But… the right name?

- Sometimes it's not so easy to find the right name…

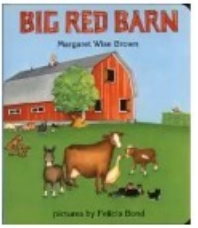
The problems with URIs...

- Problem: find the right concept
- **URI Variant problem**: in general, there can be many variants (URIs) for the same concept
- **URI Variant**: usefulness of URIs decreases exponentially with the number of ***variants***

URI Variant: meaning…



URI meaning



- Natasha: (trying to smooth things over) Ah, so it doesn't look like a duck to you Aubrey...
- Aubrey: No.
- Gregorian: What does it look like to you Aubrey?
- Aubrey: Book!

Ceci n'est pas une pipe.

Axiom 1: Global scope

- It doesn't matter to whom or where you specify that URI, it will have the same meaning

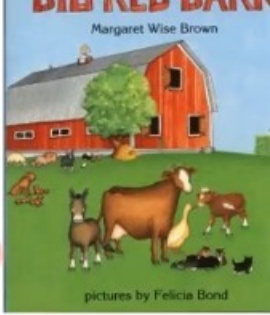
More power…

- The basic support provided by RDF-Schema has then been extended, with a specific layer in the "Semantic Web Tower"
- **OWL**
- → **W**eb **O**ntology **L**anguage

(Dis-)Equality in OWL:

- *equivalentClass*
- *equivalentProperty*
- *sameIndividualAs* (~ sameAs)

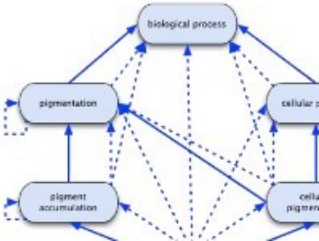
So, OWL…



- … allows to reduce the problem due to the URI Variant Law, establishing relationship among different ontologies

OWL: More power to express properties

- *inverseOf*
- *TransitiveProperty*
- *SymmetricProperty*



More power to handle property types

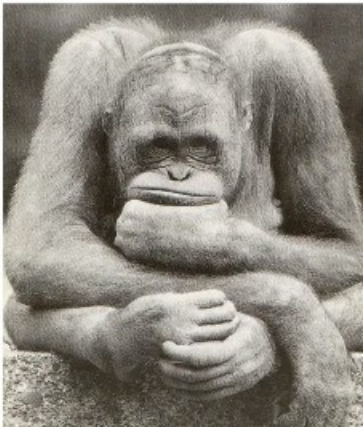
- allValuesFrom
- someValuesFrom
- minCardinality
- maxCardinality

So, more power…

- … more applications!

More power = ??

- It's information, so we would like to reason about it…



So far...

- ... we can use relationships and more to define a ***logic***: what we would like is then to do automatica calculations
- → so, having an ***executable logic***

But, fact...

- Already the super-simple first order logic (∀ for all, ∃ exists) is not decidable
- → in computer science terms, it just means the corresponding program might not terminate (!)

And so??

- Think of other contexts…
- For instance, databases: **SQL** (!)
- In its base versions, like SQL-92, every SQL «query» (program…) terminates!
- So? Why?
- Well, SQL is not Turing-complete: so it has limited expressive power, but terminates!