

# The Big Schema of Things:

*Two Philosophical Visions of The Relationship  
Between Language and Reality and  
Their Implications for The Semantic Web*

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# The Semantic Web vis-a-vis Natural Language

## SW Requirement:

**machines to use formal language in ways that humans use Natural Language (NL)**

## SW term can

*refer* to same thing as human using a NL term

*mean* the same as human using a NL term

be used to state same *truth* as human uttering NL statement

# Overview of the Argument

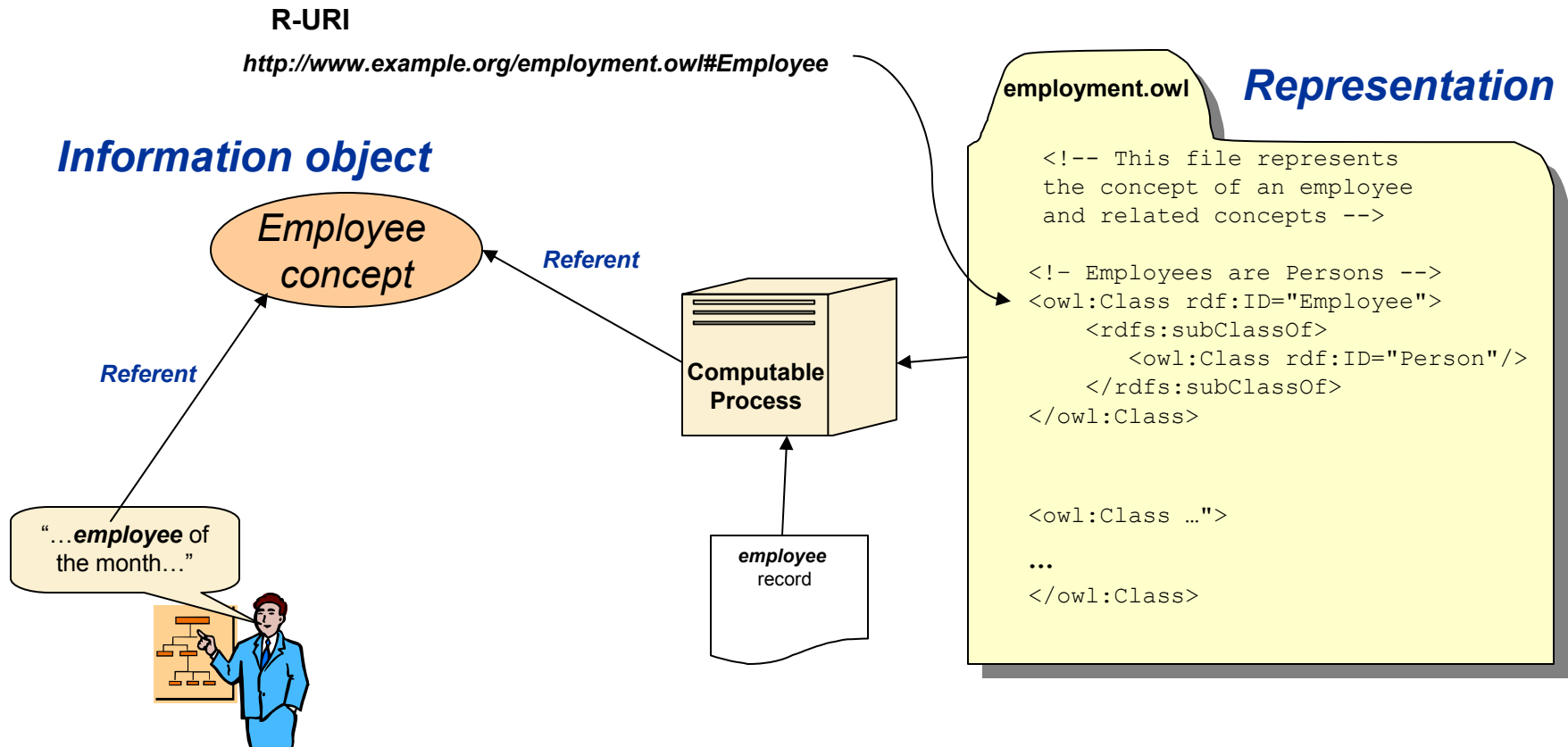
- **“Received View” of SW reference/meaning**
  - Correspondence Vision for Natural Language (NL) semantics
- **Holistic Vision & Critique of Correspondence**
  - NL semantic notions not explained by correspondence
  - Holistic “meaning-as-use” account better for NL
  - But implies NL terms typically not definable
- **Dilemma for SW development**
  - If formal methods used to define SW terms, result not likely to coincide with NL counterparts.
  - If such methods not used, how can *machines* interpret terms?
- **Resolution of Dilemma via meaning-as-use insight**

# R-URIs & The URI-Identity Crisis

- URIs give reference/meaning of SW terms (*R-URI*)
- How can URIs identify things outside the web?
- Why is this an issue?
  - Ambiguity problem: “URI-Identity crisis”
    - Refers to real world object?
    - Is a web address for a file?
      - This problem resolvable by developing syntax to mark distinction
  - Deeper *epistemological* worry
    - When a machine uses a URI referentially how do we *know* what the intended referent is?

# The Received View of SW Reference

A R-URI provides the web address of a *representation (of an information object)*. This representation can be processed to provide unambiguous (in principle) reference to an *information object* that exists independently of the web.

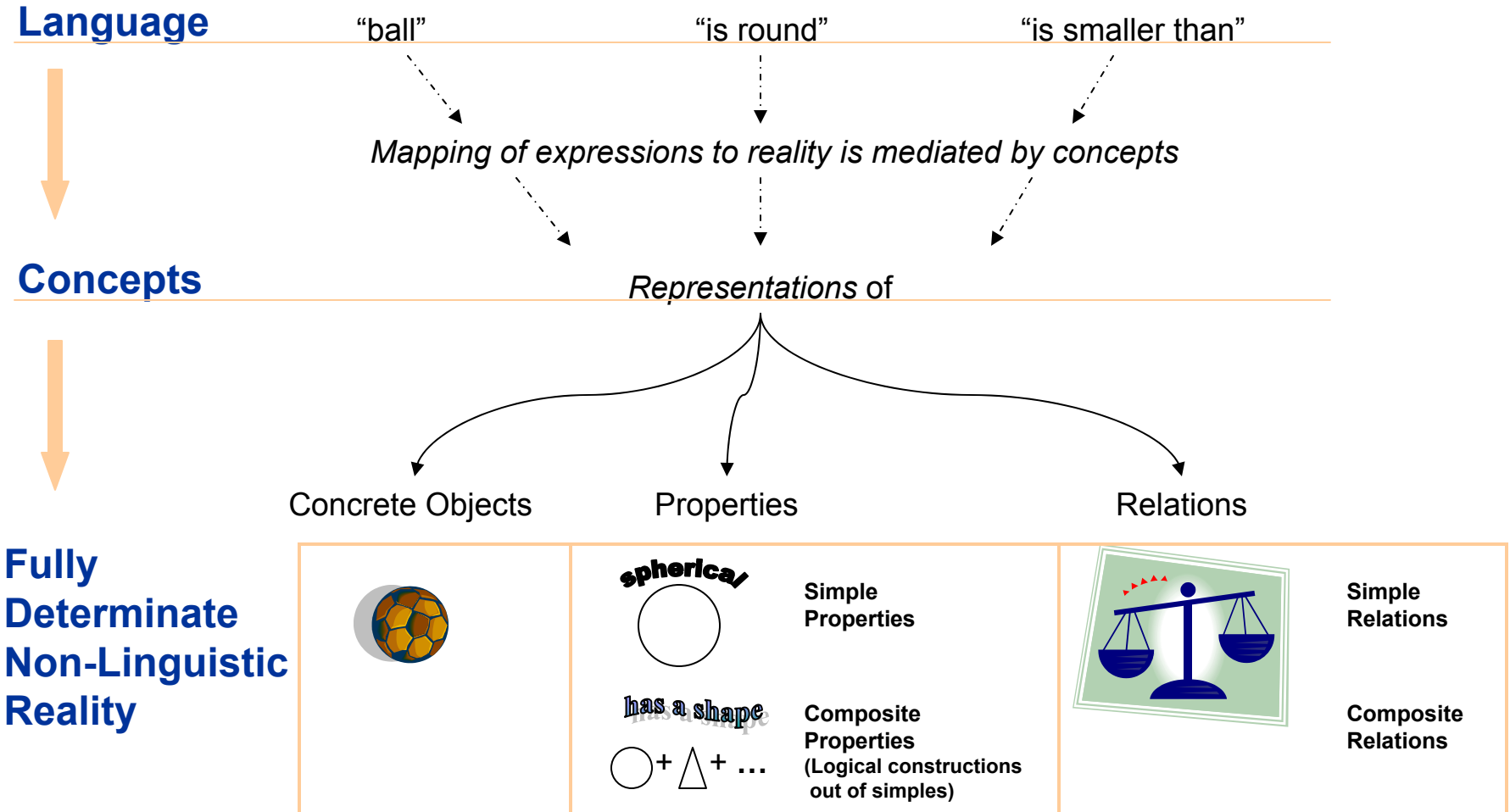


# The Correspondence Vision (1)

*Mapping language to a fully determinate reality*

- **Reality exists independently of thought/belief/language**
- **Statement is meaningful because**
  - its constituent non-logical terms correspond to “pieces of reality”
  - its logical structure portrays a possible arrangement of those pieces.
- **Statement is true if it “pictures” an arrangement in sync with the structure of reality**

# The Correspondence Vision (2) - The Three Tiers



# The Correspondence Vision (3) – Analytic Truth

- Consider *language L*
  - L has standard logical machinery
  - L's terms mapped to concepts representing fully determinate objects, etc.
- Let **C** be a term in L mapped to a concept representing a *composite* property
- Then L has statements using **C** that are *analytically* true
  - Concept *has a shape* subsumes concept *is spherical* because the properties they represent are accordingly composed.
  - *Statement* “Anything that is spherical has a shape” must be true.



# Correspondence & The Received View

- **How to represent concepts for SW?**
  - Select concept representing fully determinate piece of reality
  - Create term in chosen formal language to stand for concept
  - State analytic and significant empirical facts
- **Statements guaranteed to include “real world” as a model**
- **More statements formulated, fewer models**
- **Eventually set of statements hones in on real world**
  - singling out real world as only model (*modulo* isomorphisms)

*But watch out for the Lowenheim-Skolem Theorem!*

# The Holistic Vision (1)

- **Meaning of expression determined by its *use* in community of competent rational speakers.**
  - web of inferential and behavioral connections to other statements, beliefs, dispositions to act
- **Language & belief interwoven in a total system used to structure the world we experience.**
- **No clear-cut distinction between language, belief, and reality. Truth holistic too.**

# The Holistic Vision (2) - *Contra* Fully Determinate Language-Independent Reality

## Holist Gedanken Experiment:

Consider two communities of rational speakers

- one accepts “Object O has property P”
- other accepts “Object O does *not* have property P”

Suppose two communities have

- accounted for all relevant evidence in systems of belief
- systems resilient to all future evidence

## *Holist Conclusions:*

- *there is no “truth to the matter” (ontological indeterminate)*
  - *as to whether “O has P” is true/false*
  - *as to whether the disagreement is about reality or language*

# Ontological Indeterminacy

**When two or more incompatible conceptual systems model a domain of interest with equal empirical adequacy**

## Examples

- **Philosophical example**
  - **Descartes' "Evil Genius"**
- **Scientific example**
  - **Poincare's Conventionalism of Geometry argument**
- **Everyday life example**
  - **U.S. Constitution has/has-no right to privacy**

# Critique of Correspondence & Received View (1)

- **Attack on Analytic Truth**
  - Dogma of correspondence view (holism *a la* Quine)
  - Very few examples in NL that hold up
- **Specification of meaning of NL terms an empirical pursuit**
  - Evidence for meaning-hypotheses gathered by observing what people say and do
  - Postulate rules for use governing community of speakers
- ***But* rules of use typically not “fully determinate”**
- **Maintaining there is a “truth to the matter” in such cases goes beyond the linguistic evidence**

# Critique of Correspondence & Received View (2)

## ■ Consider rational competent speakers assent/dissent to

- whether a dog can be an employee  
“Bomb-sniffing dog newest member of U. of I. Public Safety Department”
- whether Pluto is a planet (details coming up)
- whether a “same-sex marriage” is “really” a marriage

Should SW technology require certain responses in order to use SW versions of those terms?

## ■ Unfortunately that is exactly what the received view entails.

- Crux of the problem: received view cannot distinguish between intention to use term according to certain NL community “rules of use” *and* precisely defining term.

# Is Pluto a Planet? (1)

## ■ Imagine two conflicting theories/ontologies

`http://www.ontologies.net/astro-1.owl` (a1) (pro Pluto)

`http://www.ontologies.net/astro-2.owl` (a2) (anti Pluto)

`a1:planet` R-URI for *planet* in first theory

`a2:planet` R-URI for *planet* in the second

Now consider the following statements:

– Pluto is `a1:planet` (P1) Comes out true

– Pluto is not a `a2:planet` (P2) Comes out true

## ■ Problem for received view:

– `a1:planet` & `a2:planet` *cannot* represent the same concept

– each ontology defines certain concepts for fully determinate objects, etc.

– If `a1:planet`, `a2:planet` defined the same concept then something (Pluto) would both be and not be an instance.

**P1 and P2 don't represent a substantive disagreement at all!**

# Forced Ontological Commitment

- Let `astro-1.owl`, `astro-2.owl` be authoritative ontologies.
- Astronomer A3 wants SW site with assertions about planets but does not take sides on Pluto case.
- A3 links occurrences of “planet” to one ontology or the other, thereby taking a position on the issue.
- A3 could decide to develop a neutral ontology.
  - Problem: 3<sup>rd</sup> “planet” would be totally different concept



# Meaning-as-Use

- **Accept meaning-as-use point of view**
  - Grant that NL terms cannot be precisely defined at all
  - Therefore not definable using formal methods.
- **We are then faced with the second horn of the dilemma**
  - If not by using formal definitions, how can machine-useable versions of these terms be constructed?
- **The way out of the dilemma**
  - Not necessary for NL terms to be precisely definable in order for *people* to know when they are using terms in the same way.
  - How to do that for machines?
- **Machine version of a meaning-as-use approach**
  - Record intended use of a SW term using recognized NL “dictionary” of usages
  - Use formal methods to *explicate* the intended usage, not define

# Intended Usage Records

## R-URI

<http://www.example.org/employment/employee.iur>

<u>Usage-ID:</u> 101.1		
<u>Language-Term:</u>	ENGLISH	EMPLOYEE
	SPANISH	EMPLEADO
<u>Explicated-By:</u> <a href="http://www.ontologies.net/myontology.owl">http://www.ontologies.net/myontology.owl</a>		

- Usage-ID field and Language-Term field indissolubly linked
- Dictionary of linked Usage-IDs and Language-term fields would be maintained and made accessible by a standards body.
- Explicated-By field is optional, machine-useable theory, of what this intended usage amounts to.
- R-URIs with same Usage-ID are ipso-facto “the same SW term” even if explications differ

# Avoiding Ontological Commitment

## R-URI

*http://www.FirstSchool.astro/planet.iur*

Mars is a planet[503.1]

Pluto is a planet[503.1]

Usage-ID: 503.1		
Language-Term:	ENGLISH	Planet
Explicated-By: <a href="http://www.ontologies.net/astro-1.owl">http://www.ontologies.net/astro-1.owl</a>		

## R-URI

*http://www.SecondSchool.astro/planet.iur*

Mars is a planet[503.1]

Pluto is not a planet[503.1]

Usage-ID: 503.1		
Language-Term:	ENGLISH	Planet
Explicated-By: <a href="http://www.ontologies.net/astro-2.owl">http://www.ontologies.net/astro-2.owl</a>		

## R-URI

*http://www.UndecidedSchool.astro/planet.iur*

Mars is a planet[503.1]

Usage-ID: 503.1		
Language-Term:	ENGLISH	Planet
<b>Partially-Explicating-Competitors:</b> <a href="http://www.ontologies.net/astro-1.owl">http://www.ontologies.net/astro-1.owl</a> <a href="http://www.ontologies.net/astro-2.owl">http://www.ontologies.net/astro-2.owl</a>		

# What is “Explication?”

- Use theory in *explicated-by* field for truth-value of SW statements
  - Same as current practice
  - But separation of intended-usage from definition allows alternatives
- Partially-Explicating-Competitors field illustrates this point
  - Use notion of *supervaluation* for truth value (after Bas van Fraassen)
    - Any statement assigned true/false by *all* competing theories is assigned same
    - Otherwise statement is not assigned a truth value by supervaluation
      - Note that this means that any logical truth, such as, “Either Pluto is a planet or Pluto is not a planet” is assigned true by the supervaluation.
- Otherwise, beyond the scope of this discussion, i.e., future work

# Conclusion

- **Discussion of semantic notions for NL a primary concern of modern philosophy**
- **Not surprising nor unwelcome for SW to raise such discussions**
- **Holistic vision, and meaning-as-use, has had little influence in computational knowledge representation thus far.**
- **Hopefully this work shows how some of those insights can be employed**