CSC 481: Semantic Modeling

Based on Chapter 2 of “Semantic Web for the Working Ontologist - Modeling in RDF, RDFS and OWL” by Allenmag and Hendler

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Models and the Semantic Web

The Semantic Web is chaotic, but models help us make sense of this mess!

Some roles of models:

- “Models help people communicate
- Models explain and make predictions
- Models mediate among multiple viewpoints”

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Models

Communication

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Some roles of models:

- “Models help people communicate”
  - Organizing agreed-upon information for sharing (topics, categories…)
- “Models explain and make predictions”
  - Making sense of phenomena in the absence of a trusted authority
- “Models mediate among multiple viewpoints”
  - Organizing the varied ways in which a concept might be expressed

Modeling for human communication

Examples of models meant for human communication

- Laws
- Tax codes
- Scientific theories
- Tagging of products in an online store (by the store itself or the community)
- Slides about the semantic web 😉

Often expressed in Natural Language

Formal vs Informal models

Informal models rely on the (human) reader for interpretation of meaning.

- Often higher layers of models provide context to lowers ones, increasing formality
    - e.g. Constitution -> National Laws -> Regional laws
- Formality is not black and white
    - At some point, we fall back to natural language and human interpretation

Modeling for explanation and prediction

Examples of models meant for human communication

- Explanations relate phenomenon to “first principles” (formalism)
  - e.g. the apple fell because of gravity
- The same principles can be used for prediction
  - e.g. if I throw the apple at a certain angle and velocity, where will it land?
- A good formalism reduces the need for layered models
- Within the formalism of the semantic web (as with logic), explanations and predictions are related to the idea of inference

Mediating variability

- Local approach: one entity administers the data
  - Not suited for Semantic Web
- Another approach: every entity represents its data independently
  - Too informal, hard to agree on anything without human independent
- We can use hierarchy and subclasses to organize commonalities and variability among concepts

Examples: different ways to model planets

The official IAU definition

- A planet is a body that:
    1. Orbits the sun
    2. Has enough mass to be approximately round
    3. Has “cleared the neighborhood” around its orbit
- Every object that satisfies 1 is a “Solar System Body” (SSB)
- If it satisfies 1 but not 2 or 3, it is a *small* SSB
- If it satisfies 1 and 2 but not 3, it is a dwarf planet

Other notions of planet

Subclass diagrams

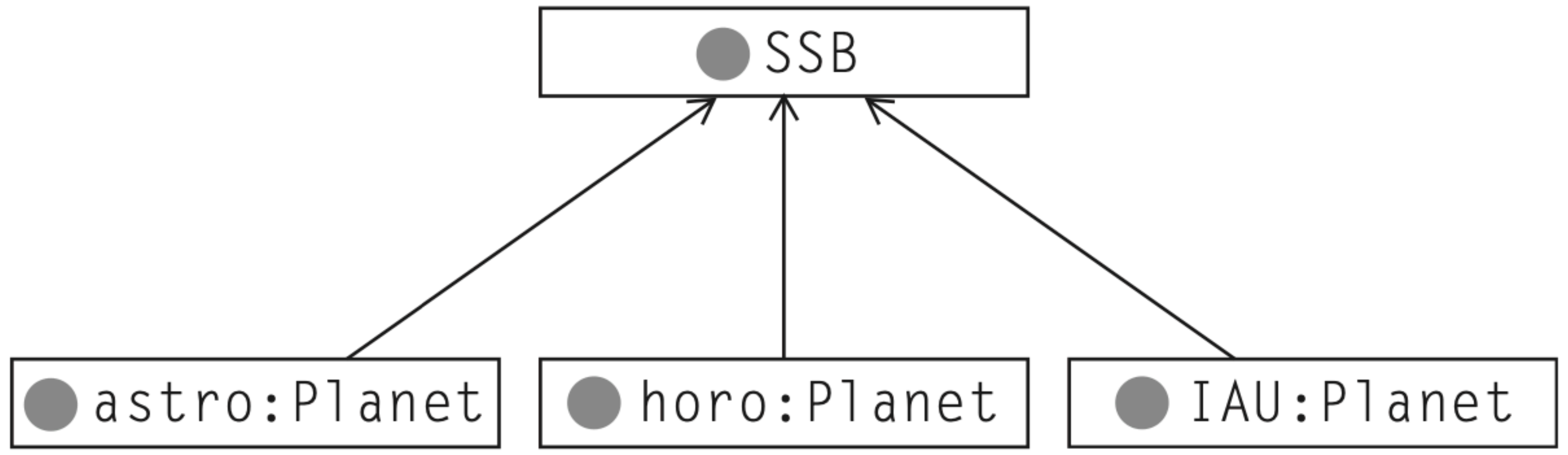


FIGURE 2-1

Subclass diagram for different notions of *planet.*

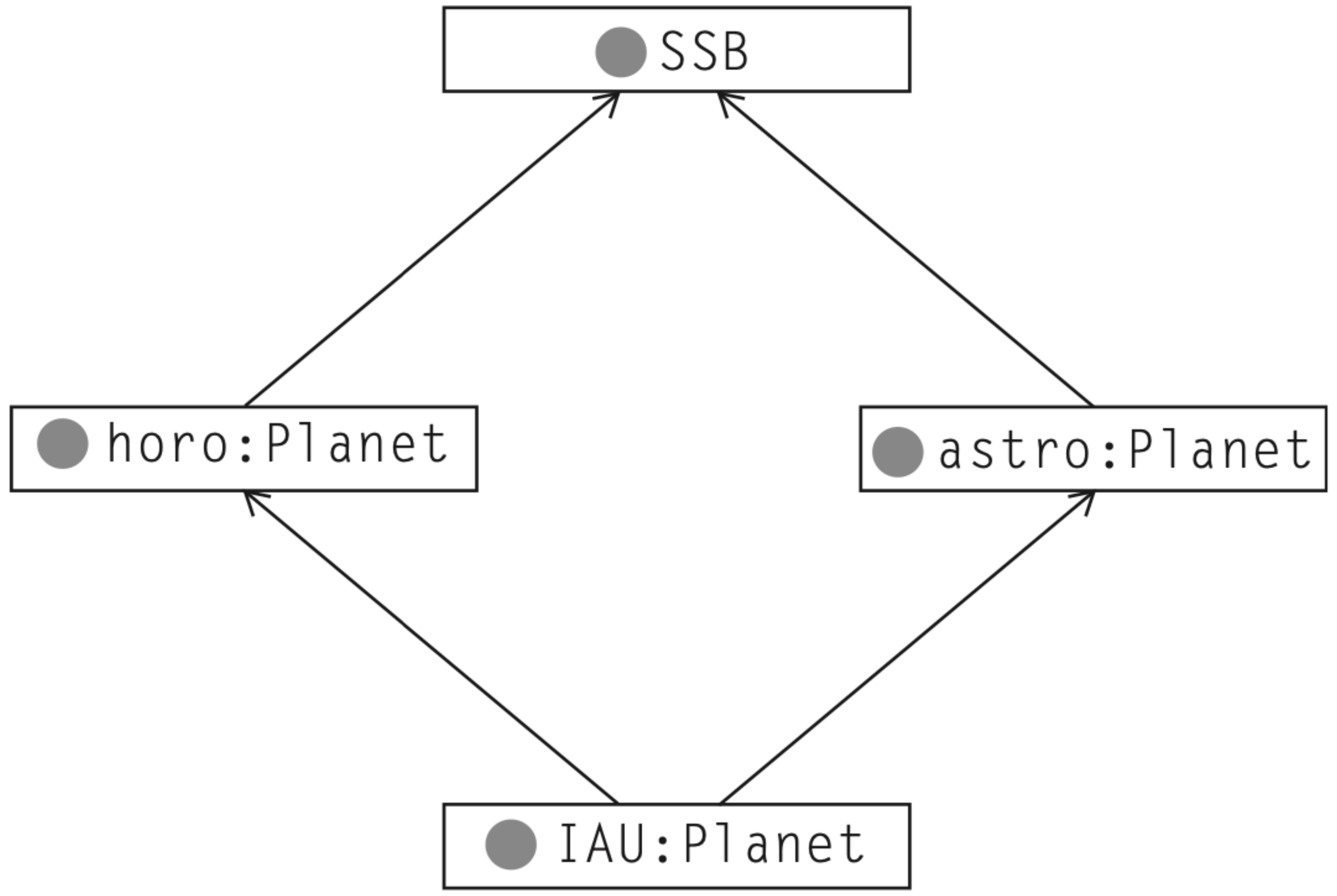
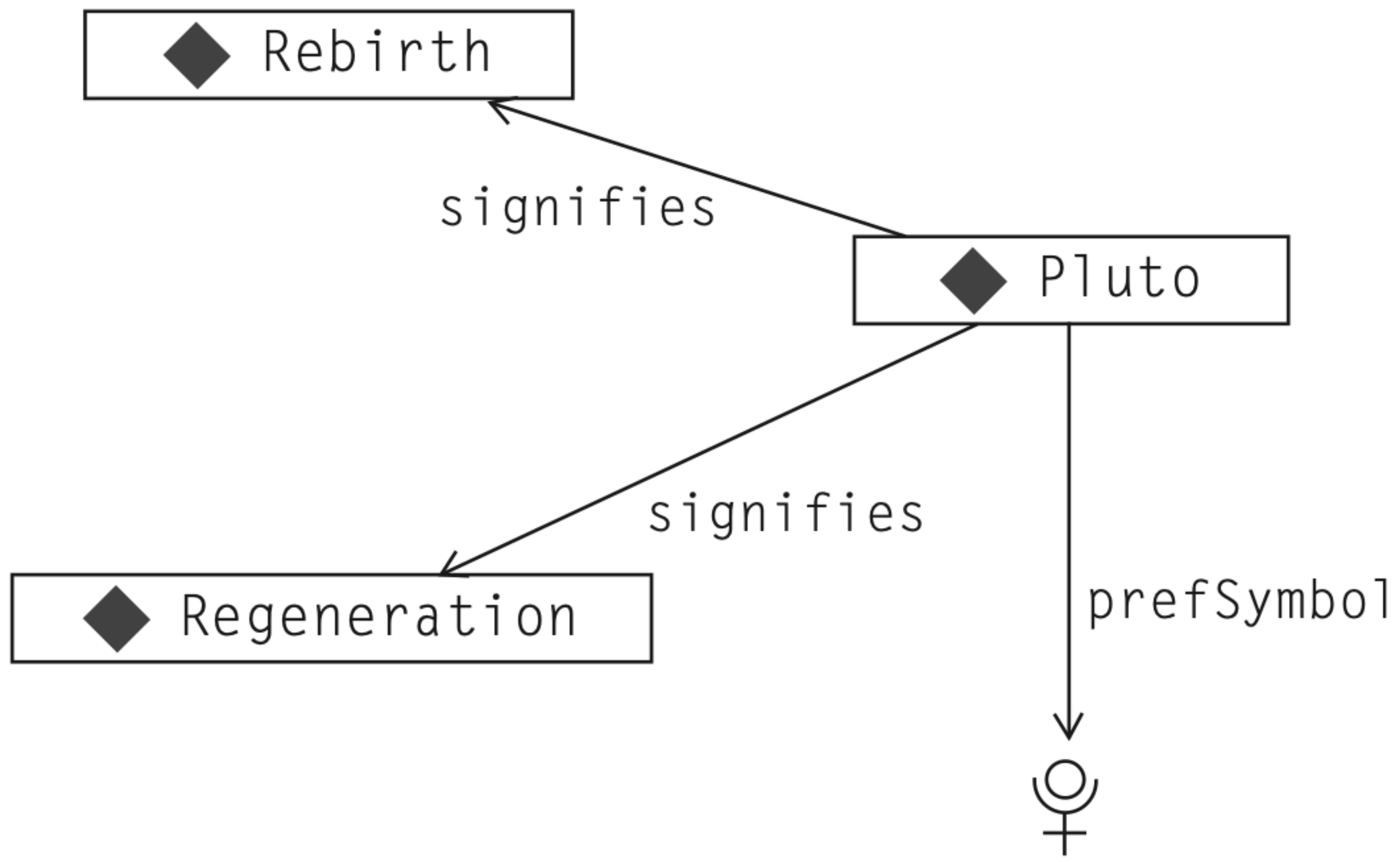


FIGURE 2-2

More detailed relationships between various notions of *planet.*

Linking objects and their attributes

Diferent layers



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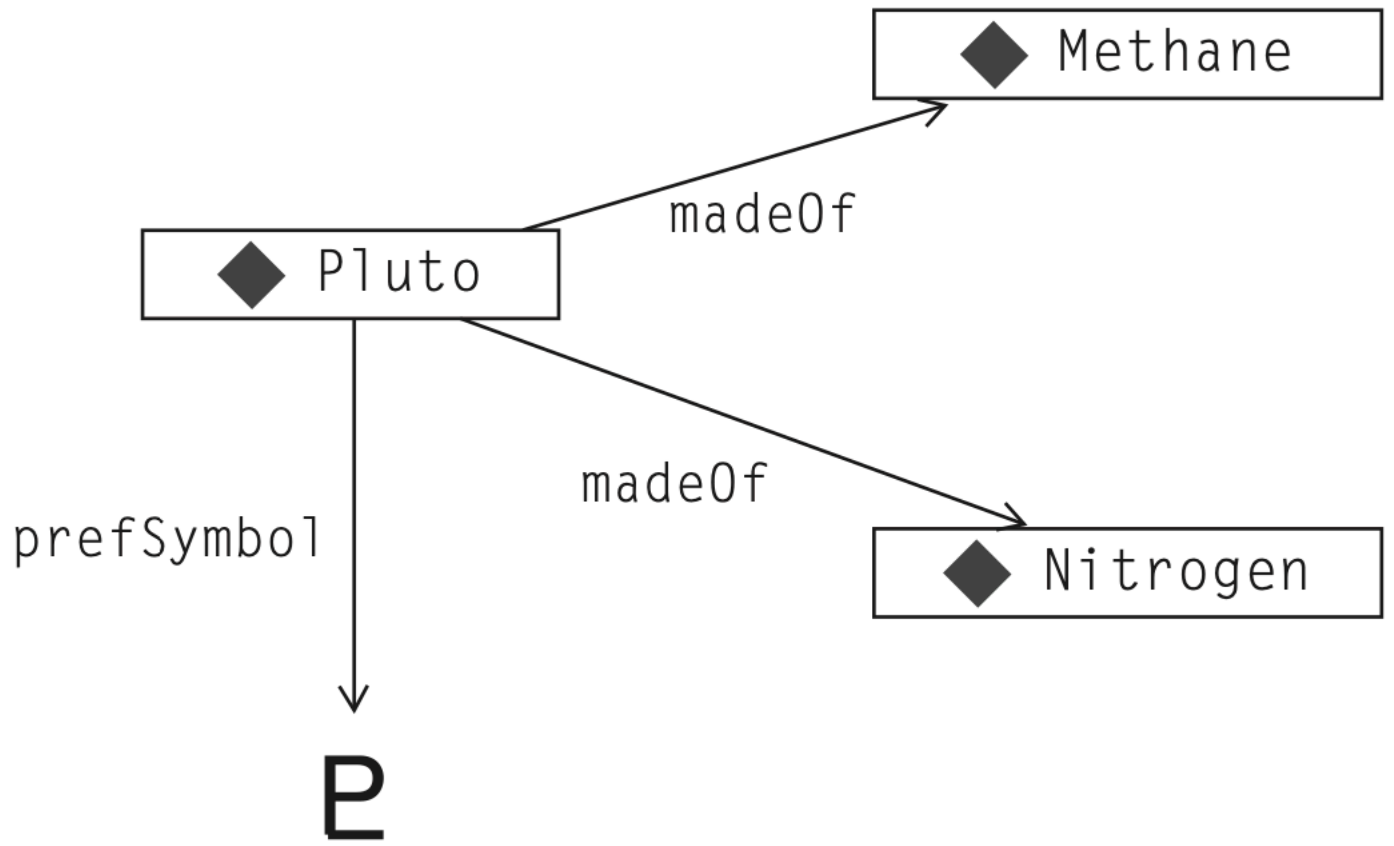

(b)

Attributes relevant to the “horoscope layer” of Pluto

Attributes relevant to the “astronomy layer” of Pluto

Merging different models

- As we'll see, RDF lets us merge models on the common concept

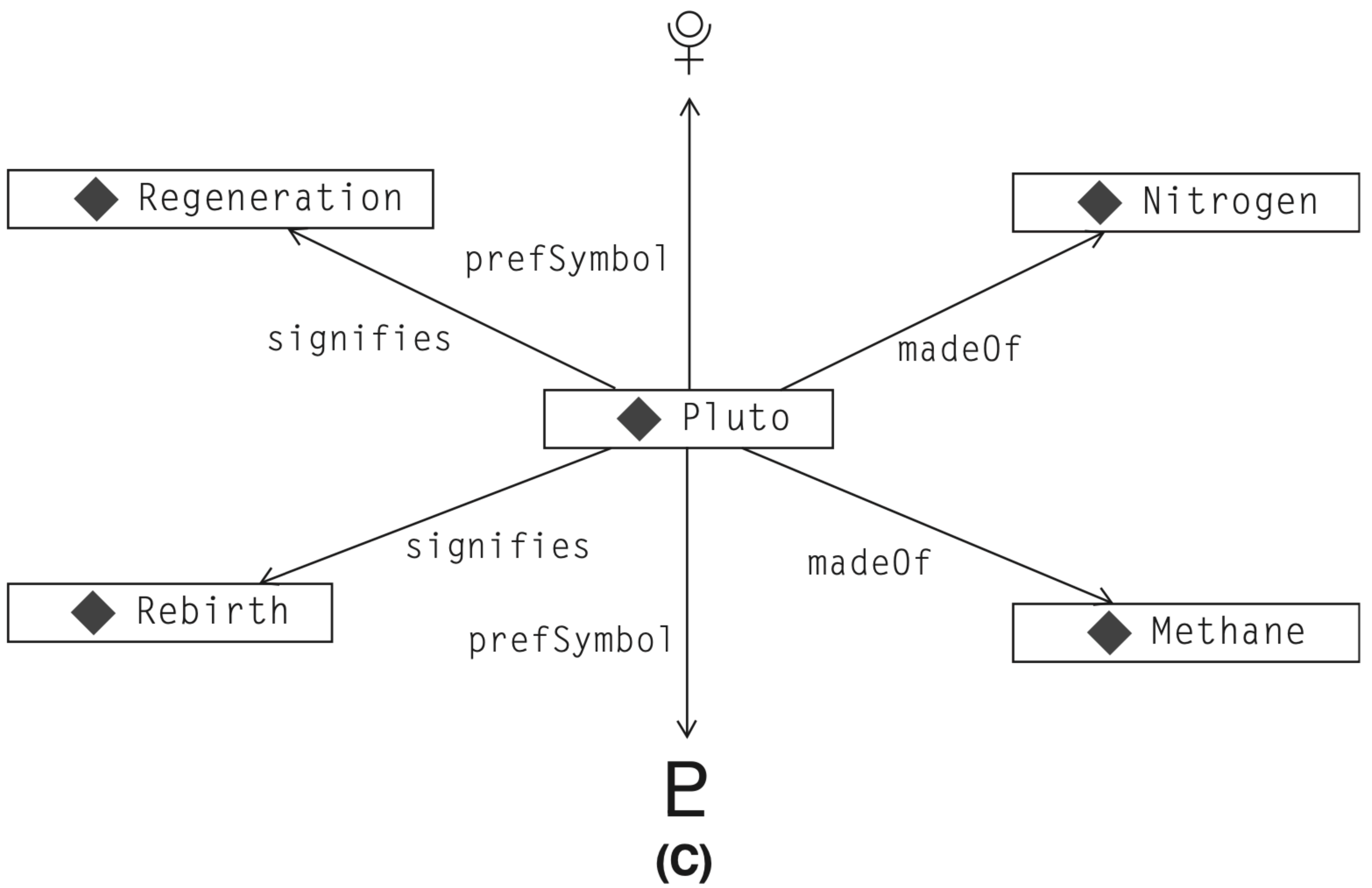

FIGURE 2-3

Layers of modeled information about Pluto.

Making sense of differing views

Levels of expressivity

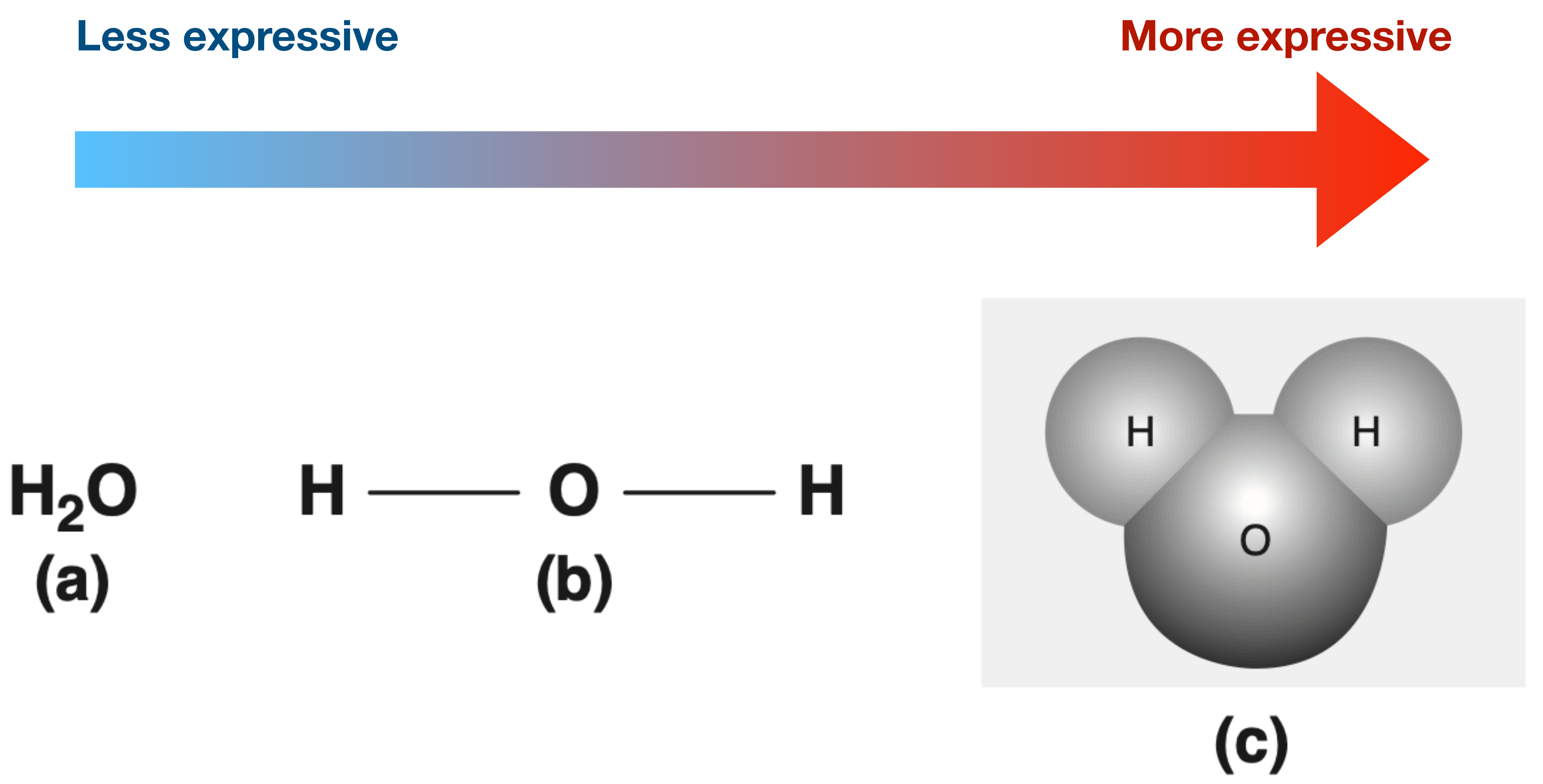

FIGURE 2-4

Different expressivity of models of a water molecule.

Making sense of differing views

Levels of expressivity of Semantic Web standards

Less expressive

- **RDF - Resource Description Framework.** Models data as triplets (subject, predicate, object)
- **RDFS - RDF Schema language.** Enhances RDF with notions of classes, subclasses and properties.
- **OWL - Web Ontology Language.** adds more vocabulary for describing properties and classes (e.g. disjointness, cardinality, symmetry of properties…)
  - Related to Description Logics (ch. 9 of the Brachman & Levesque book)

More expressive

Fundamental Concepts

Fundamental Concepts

The following fundamental concepts were introduced in this chapter.

Modeling—Making sense of unorganized information.

Formality/Informality—The degree to which the meaning of a modeling language is given independent of the particular speaker or audience.

Commonality* and *Variability—A fundamental aspect of the Semantic Web that a model can represent.

Expressivity—The ability of a modeling language to describe certain aspects of the world. More expressive modeling language can express a wider variety of statements about the model. Modeling languages of the Semantic Web—*RDF, RDFS,* and *OWL*—differ in their levels of expressivity.