Ontological Indeterminacy and the Semantic Web

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ABSTRACT

Ontological indeterminacy (OI) involves incompatible conceptual systems being applicable to a domain with equal empirical adequacy; a phenomenon familiar in philosophy, but also present in the sciences and everyday life. This article presents arguments and a detailed use-case showing how OI causes problems for what seems to be a widespread, if implicit, understanding of how semantic Web (SW) terms refer or have meaning, namely: the referent/meaning of a SW term is established through precise definitions given in a formal ontology. We show that this account is incompatible with the key requirement that SW terms/statements be similar in meaning to corresponding natural language terms/statements. We present a new account, based on a "meaning as use" philosophy of language, that avoids these problems by formalizing the distinction between the intention to use a term in a customary manner and the decision to adopt a formal theory that explains or explicates that usage.

Keywords: meaning; meaning-as-use; ontologies; philosophy of language; reference; semantics; Web technologies

INTRODUCTION

According to the World Wide Web Consortium's (W3C) page on the semantic Web activity (http://www.w3.org/2001/sw/), the semantic Web (SW) is "about two things:"

… common formats for interchange of data… Also it is about language for recording how the data relates to real world objects. *That allows a* person, *or a* machine, *to start off in one database, and then move through an unending set of databases, which are connected not by wires but by being about the same thing.* (emphasis added.)

Though couched in terms of databases, this paragraph implies that the SW should make it possible for machines to interpret and make *statements* about "real world objects" that would be direct analogues to human-generated statements about the same things. In order for the formal language used by a machine to have the same kind of relationship to reality as natural language used by a human, there must be a way for the reference/meaning of SW terms to be established. A key idea behind the SW is to use *uniform resource identifiers* (URIs) to play this role by allowing them to be used to "identify" real world objects, properties, and relations. Although there has been some

controversy concerning technical details (Clark, 2002; Pepper, 2003) it seems clear that schemes allowing URIs to be used to *refer to things* (while still allowing them to be used as addresses in URLs) is compatible with established protocols (Ginsberg, 2006; Halpin & Thompson 2005; Pepper, 2003).

All relevant accounts, beginning with IETF RFC 2396 (Berners-Lee et. a1., 1998), and up to and including recent Web architecture work in W3C TAG (Lewis, 2007), accept and utilize the fundamental idea that URIs can be used to *refer* to ("identify") things ("resources"), whether these be Web pages, or objects, properties, relations, etc. existing independently of the Web. Thus, in contrast to the *uniform resource locators* (URLs) of the original Web, which can be thought of as being "addresses" for "locations" in a virtual space (the Web), the SW requires that URIs also be used *linguistically* by agents in various contexts to make certain statements, just as *words* uttered by humans in various contexts can be used to do the same. In this article, when a URI is used in this manner we will say that it is used *referentially*; we will also use the term "referential-URI" (*R-URI* for short) to designate this type of SW usage.

For a *uniform resource locator* (URL) there is no question about what it "refers to" or "means:" a URL is simply a kind of address, and one can only use it to attempt to retrieve whatever item (if any) is stored at the corresponding location. If it "identifies" anything, it identifies a virtual location (*not* the *contents* of the location).[2] But when a URI is used referentially on the SW, how is an agent, especially a non-human one, supposed to "understand" or "know" what its intended referent or meaning is? Given that R-URIs can be used as subjects, predicates, and objects in statements in RDF and other SW languages, it is vital that a SW agent be able to determine when they are being used to refer to the same resource or different ones. While syntactic identity of R-URIs is a sufficient condition for resource-identity, it is not a necessary one. Syntactically different URIs can refer to the same resource. And, of course, even though identical R-URIs must refer to the same resource, there is still the issue of how a machine determines *what* that resource is. Or to put it another way, what exactly has to be the case for it to be true to say that a machine is using an R-URI to refer to a resource?

According to what we will call "received dereferencing practice" for using R-URIs, as outlined in, for example, (Lewis ed., 2007), the intended meaning or referent of an R-URI is given by using the R-URI as a URL for a "Web-presence" that is capable of providing *some* kind of formal, machine-processable, information that *can* be used to establish an intended referent or meaning. The exact protocol and/or mechanism by which this information is conveyed is immaterial to this article. What is important for our discussion is that depending upon the kind of information provided and what one means by "establishing" an intended referent/meaning, there are potentially many different ways of understanding and implementing this practice.

The Ontologically-Defined View of Semantic Web Reference/Meaning

Within the broad community of computational ontologists and SW practitioners, there seems to be a widespread, if implicit or unstated, way of understanding the aforementioned received dereferencing practice for R-URIs. It amounts to the following: to provide a meaning/referent for an R-URI the responsible Web-presence should return (or provide reference to) a formal ontology that includes (or imports) a precise definition for the resource (object, property, or relation) the R-URI is intended to pick out. By a "precise definition" we do not necessarily mean a set of necessary and sufficient conditions for something's being (or being an instance of) the resource in question. Rather, by "precise definition" we mean a set of formal expressions that are held to be unambiguously true or false in any given applicable case and that can help a SW agent determine the intended referent/meaning of the term, i.e., a SW agent in possession of this ontology can, *ipso facto*, correctly use the term to designate its intended referent or with the intended meaning. We will

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