Chapter 7
Identity in the Real World

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ABSTRACT

The notion of identity has been discussed extensively in the past. Leibniz was the first to present this notion in a logically coherent way, using a formulation generally recognized as "Leibniz's Law". Although some authors criticized this formulation, Leibniz's Law is generally accepted as the definition of identity. This chapter interprets Leibniz's Law as a limit notion: perfectly reasonable in a God's eye view of reality, but very difficult to use in the real world because of the limitedness of finite agents. To illustrate our approach we use "description logics" to describe the properties of objects, and present an approach to relitivize Leibniz's Law. This relativization is further developed in a semantic web context, where the utility of our approach is suggested.

INTRODUCTION

While the notion of identity is commonly used in the scientific field, its formal definition is not so straightforward. In the past many philosophers proposed a range of techniques to define and deal with it. However we have to wait until the so called "Leibniz's Law" (LL), to achieve a definition that undercovered its intimate connection with logic and ontology.

One of the main aspects of LL is its dependence on the notion of property. Second-order logic is required to characterize properties, and therefore to formulate LL. While generally accepted, some philosopher criticized the characterization of identity proposed by LL. Moreover even if accepted as a definition, the logical formalization of LL poses some problems. There is no complete calculus for second-order logic, and LL requires second-order logic for its formulation. Additionally, second-order quantification commits to the existence

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of properties. This fact is sometimes considered problematic by philosophers and logicians.

To prevent some of these problems, we use description logics (DLs). DLs provide us a mean to deal with properties in a first-order logic environment, and allow us to make quantification over properties less problematic. The use of DLs is justified by the consideration that finite agents are able to access only a restricted set of properties. Moreover, DLs are decidable. This is compatible with the idea of construction of software agents using DLs and deciding identity between two objects.

A paradigmatic environment in which it is reasonable to consider software agents using DLs and dealing with objects is semantic web. An applicative example is presented and discussed in order to illustrate the usefulness of our idea.

The work is organized as follows: Section 2 presents the required philosophical and logical preliminaries, Section 3 presents our idea, and Section 4 draws some conclusions and suggests additional researches. More precisely, Section 2 presents an historical and philosophical overview of some attempts to characterize identity (2.1, 2.2, 2.3, 2.4) and discusses some foundational issues about identity (2.4, 2.5). The final subsections of Section 2 present some basics of DLs and our motivations for using them (2.7, 2.6). Section 3 presents a relativization of identity with respect to agents (3.1, 3.2) and discusses an example of application of the idea (3.3).

BACKGROUND

Logic and Metaphysics

"To say that things are identical is to say that they are the same." (Noonan 2008). This is the notion of *numerical* (or *absolute*) *identity*, which the tradition distinguished from, for example, *qualitative* identity, i.e. when two objects share some properties. For the scope of this work with "identity" we will mean numerical identity. Moreover we will deal with *contemporary* characterizations of identity.

It is only with Frege and Peano (late XIX century) that we achieved the conceptual framework we use today in logic and in philosophy of language (see their fundamental works (Frege 1879) and (Peano 1889)). For example, Peano distinguished between different forms of predication: the difference between "Cats are feline" (inclusion between classes) and "Mark is human" (membership of an element to a class) was not clearly formulable before the XIX century.

Identity is generally considered a binary relation. However this poses a problem: is identity a relation between objects or between names for objects? The question is not as naïve as it seems: Frege, founder of modern logic, in (Frege 1884), accepted one of Leibniz's characterizations of identity as his definition of equality:

Eadem sunt quorum unum potest substitui alteri salva veritate[1]

This sentence hides a confusion between use and mention, as observed by (Church 1956, p. 300), that corrects:

(S) "Things are identical if the name of one can be substituted for that of the other without loss of truth."

We have to add the clause that the substitution must occur in *referential* contexts, because in *opaque* (or intensional) contexts names for the same thing could not be substituted *salva veritate*[2].

This characterization of identity is of linguistical flavour: it deals with substitutions of names denoting objects, and is pre-theoretical. In fact, (S) is a formulation of what is generally called the substituting principle.

There are other ways of thinking about the same notion. Identity can also be thought in one of the following alternative ways: