Properties of Semantic Relations in Ontology-based Computer Resources

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Categorical or relational propositions [1, 2] form the basis of several knowledge representation and argumentation tools such as ontologies, ontology based linguistic resources [8] and concept and argumentation maps [3]. However, the authors of these tools systematically commit errors in the representation of categorical propositions. These errors include, among others [3, 4], linking concepts that turn the propositions into false ones, vaguely and arbitrarily chosen relations that cannot be interpreted by peers and incorrect usage of syllogistic properties, such as transitivity, that lead to wrong conclusions.

Hence, the semantics of binary relations must be defined as clearly as possible and the construction of the network must be as controlled as much as possible, in order to avoid the aforementioned mistakes. We have devised a way to help users minimize the occurrence of these errors and shown that these ideas can be easily implemented using relational databases and logic programming, to provide a feedback schema that presents the logical consequences of asserting a proposition [5].

One of the foundations of our approach is the set of properties of binary relations, denominated by some researchers [6, 7] as algebraic properties of relations. These properties are: symmetry, antisymmetry, asymmetry, transitivity, intransitivity, reflexivity and irreflexivity which are arranged into seven triplets over which there is a certain level of agreement [5]:

- (Antisymmetric, Reflexive, Transitive). The combination of this triplet typifies any partial order. Examples of this triple are: "is a" and "less or equal than".
- (Asymmetric, Irreflexive, Transitive). A binary relation with this triplet is used to state that the referent is greater than or less than the referent, by some objective or subjective scale. Examples of this triplet are: "ancestor of", "greater than" and "less than".
- (Asymmetric, Irreflexive, Intransitive). This triplet asserts that the referent is the agent of the verb or has the property of the noun that describes the relation. Examples of this triplet are: "father of", "sitting on the legs of" and "starred in".

adfa, p. 1, 2011.

- (Symmetric, Irreflexive, Intransitive). Binary relations expressing kinship or social status, but that do not imply what Lyon (1977) calls converseness, are defined by this triple. For instance: “married to”, “sibling of”, and “first cousin of”.
- (Symmetric, Reflexive, Intransitive). All compatibility, proximity or tolerance relations are described by this triplet. It declares that both the referent and the relatum are close to each other, share something, or have something in common, by some objective or subjective scale or measure. Examples of these binary relations are: “has/have at least 2 grandparents in common with” and “is within a distance of X kilometers from” and “shares a border with”.
- (Symmetric, Reflexive, Transitive). This triplet characterizes all equivalence relations such as: “as tall as”, “equal to” and “means the same as”.
- (Antisymmetric, Irreflexive, Intransitive). A relation defined by this triplet represents cause-effect relations, which are assumed to be relative to a particular domain, and are normally associated with laws or regularities which govern that domain and act as constraints upon what may happen.

In this paper, it is shown that the number of properties needed can be minimized, by using asymmetry, instead of antisymmetry, in all of the corresponding triplets, i.e. partial order structure and cause-effect one, and that this simplification does not alter the semantics of the relations defined by those triplets.

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