**About the logical expressions of the CRM**

The present CRM specifications are annotated with logical axioms, providing an alternative formal expressions of the CRM ontology. This section briefly introduces the assumptions that are at the basis of the logical expression of the CRM (for a fully detailed account of the logical expression of semantic data modeling, see [1]).

The CRM is expressed in terms of the primitives of semantic data modelling. As such, it consists of:

* *classes,* which represent general notions in the domain of discourse, such as the CRM class *E21 Person* which represents the notion of person;
* *properties,* which represent the binary relations that link the individuals in the domain of discourse, such as the CRM property *P152 has parent* linking a person to one of the person’s parent.

Classes and properties are used to express ontological knowledge by means of various kinds of constraints, such as sub-class/sub-property links, e.g., *E21 Person* is a sub-class of *E20 Biological Object*, or domain/range constraints, e.g., the domain of *P152 has parent* is class *E21 Person.*

In contrast, first-order logic-based knowledge representation relies on a language for formally encoding an ontology. This language can be directly put in correspondence with semantic data modeling in a straightforward way:

* classes are named by *unary predicate symbols*; conventionally, we use E21 as the unary predicate symbol corresponding to class *E21 Person*;
* properties are named by *binary predicate symbols*; conventionally, we use P152 as the binary predicate symbol corresponding to property *P152 has parent.*

Ontology is expressed in logic by means of *logical axioms*, which correspond to the constraints of semantic modelling. These axioms use the well-known non-logical symbols (and for conjunction, or for disjunction, implies for implication, not for negation, forall for universal quantification and exists for existential quantification) and the predicate symbols representing the involved classes and properties. For instance, the above sub-class link between *E21 Person* and *E20 Biological Object* can be formulated in logic as the axiom:

(forall x) [E21(x) implies E20(x)]

(reading: for all individuals x, if x is a E21 then x is an E20). In the specifications, universal quantifiers are omitted for simplicity, so the above axiom is simply written:

E21(x) implies E20(x)

Likewise, the above domain constraint on property *P152 has parent* can be formulated in logic as the axiom:

P152(x,y) implies E21(x)

(reading: for all individuals x and y, if x is a P152 of y, then x is an E21).

These basic considerations should be used by the reader to understand the logical axioms that are inserted into the present specifications. If the reader wishes to know the complete first-order language that has been used for the logical expression of the CRM, he is referred to [2].

**References**

[1] R. Reiter (1984). Towards a logical reconstruction of relational database theory. In Brodie, M. L., Mylopoulos, J., and Schmidt, J. W., editors, On Conceptual Modelling, pages 191–233. Springer Verlag, New York, NY.

[2] C. Meghini and M. Doerr (2016). A first-order logic expression of the CIDOC Conceptual Reference Model. Submitted for publication.