On the Semantics of Associations and Association Ends in UML

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Abstract:
Association is one of the key concepts in UML that is intensively used in conceptual modeling. Unfortunately, in spite of the fact that this concept is very old and is inherited from other successful modeling techniques, a fully unambiguous understanding of it, especially in correlation with other newer concepts connected with association ends, such as uniqueness, still does not exist. This paper describes a problem with one widely assumed interpretation of the uniqueness of association ends, the restrictive interpretation, and proposes an alternative, the intentional interpretation. Instead of restricting the association from having duplicate links, uniqueness of an association end in the intentional interpretation modifies the way in which the association end maps an object of the opposite class to a collection of objects of the class at that association end. If the association end is unique, the collection is a set obtained by projecting the collection of all linked objects. In that sense, the uniqueness of an association end modifies the view to the objects at that end, but does not constrain the underlying object structure. This paper demonstrates how the intentional interpretation improves expressiveness of the modeling language and has some other interesting advantages. Finally, this paper gives a completely formal definition of the concepts of association and association ends, along with the related notions of uniqueness, ordering, and multiplicity. The semantics of the UML actions on associations are also defined formally.

Keywords:
model-driven development, Object-oriented modeling, Unified Modeling Language (UML), conceptual modeling, association, formal semantics, association end