A Generic Schema Evolution Approach for NoSQL and Relational Databases[*]

Alberto Hernández Chillón[1] , Meike Klettke[2] , Diego Sevilla Ruiz[1] , and Jesús García Molina[1]

[1] Faculty of Computer Science, University of Murcia, Murcia, Spain
{alberto.hernandez1,dsevilla,jmolina}@um.es
[2] Faculty of Computer Science and Data Science, University of Regensburg, Regensburg, Germany
meike.klettke@ur.de

Abstract. In the same way as with relational systems, schema evolution is a crucial aspect of NoSQL systems. But providing approaches and tools to support NoSQL schema evolution is more challenging than for relational databases. Not only are most NoSQL systems schemaless, but different data models exist without a standard specification for them. Moreover, recent proposals fail to address some key aspects related to the kinds of relationships between entities, the definition of relationship types, and the support of structural variation.

In this article, we present a generic schema evolution approach able to support the most popular NoSQL data models (columnar, document, key-value, and graph) and the relational model. The proposal is based on the Orion language that implements a schema change operation taxonomy defined for the U-Schema unified data model that integrates NoSQL and relational abstractions. The consistency of the taxonomy operations is formally evaluated with Alloy, and the Orion semantics is expressed by translating operations into native code to update data and schema. Several database systems are supported, and the engine built for each of them has been validated by testing each individual SCO and refactoring study cases. A study of relative execution time of operations is also shown.