

A Structural $\mathcal{SHOIN}(\mathcal{D})$ Ontology Model for Change Modeling

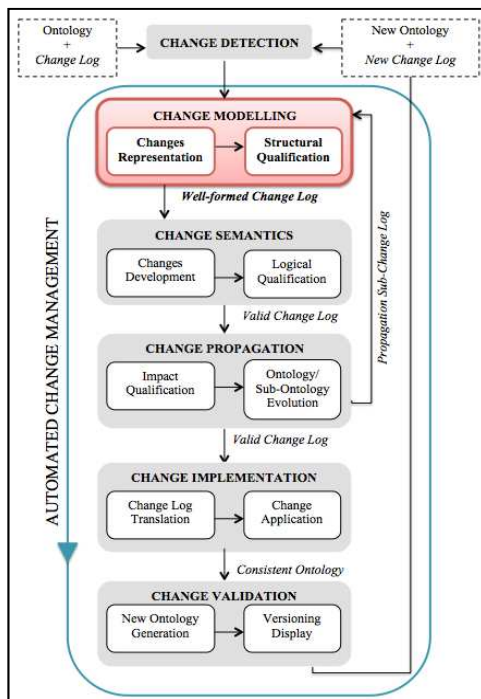
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Problem statement

- Any ontology needs to be revised and refined until an ontological commitment between the knowledge modeled and the model is found. Ulterior updates of the ontology, addressed by ontology evolution, aim at responding to changes in the domain and/or the conceptualization (Flouris, 2008). Changes are consequently inherent in the ontology life cycle.
- Modeling changes implies having an exhaustive and non-ambiguous definition of the ontology model according to its language, so that each
- element of the ontology impacted by changes can be formally described.

Contributions

- A framework is defined in order to develop an $\mathcal{SHOIN}(\mathcal{D})$ ontology model
- To formalize our framework the Karlsruhe Ontology Model (Ehrig, 2004) is used and extended to cover the whole $\mathcal{SHOIN}(\mathcal{D})$ constructors.
- A $\mathcal{SHOIN}(\mathcal{D})$ ontology is a structure $O = (SO, \sigma O, FO)$ consisting of:
 - The underlying set SO containing:
 - Six disjoint sets $sC, sT, sR, sA, sI, sV, sKR$ and sKA called concepts, datatypes, relations, attributes, instances, data values, relation characteristics (among Symmetric, Functional, Inverse Functional, Transitive) and attribute characteristics (Functional),
 - Four partial orders \leq_C, \leq_T, \leq_R and \leq_A , respectively on sC called concept hierarchy or taxonomy, on sT called type hierarchy, on sR called relation hierarchy and on sA called attribute hierarchy, such that $SO := \{(sC, \leq_C), (sT, \leq_T), (sR, \leq_R), (sA, \leq_A), sI, sV, sKR, sKA\}$,
 - The signature σO containing two functions $\sigma_R: sR \rightarrow sC \times sC$ called relation signature and $\sigma_A: sA \rightarrow sC \times sT$ called attribute signature, such that $\sigma O := \{\sigma_R, \sigma_A\}$,
 - The interpretation function FO containing all necessary sub-functions for concept, data type, relation, attribute instantiation, characterization, equivalence, etc.
- To model changes, we give the six definitions below :



Change

- A change ω is the application of a modification on an ontology O , that potentially affects one or more elements of its structure as defined by the $\mathcal{SHOIN}(\mathcal{D})$ Ontology Model.

Log of changes

- Given an ontology O a log of changes, noted \log_i , is defined by an ordered set of changes (simple and complex) $\langle \omega_1, \dots, \omega_n \rangle$ that applied to O results in O' .

Basic change

- A basic change on an ontology O is a function $\omega_B: sK \rightarrow 2^O$ with $sK := \{sC \cup sI \cup sR \cup sA\}$ that corresponds to an addition, a removal of a modification of one element $\in O$.

Complex change

- A complex change on an ontology O is a disjoint union of basic changes. It is a function $\omega_C: nsK \rightarrow 2^O$ such that $\omega_C := \omega_{B1} + \dots + \omega_{Bn}$.

Insertion of a change

- The addition of a change ω_i traced in the log of changes \log_i , noted $\log_i + \{\omega_i\}$, is defined by the disjoint union between the two disjoint sets \log_i and $\{\omega_i\}$.

Deletion of a change

- The deletion of a change ω_i traced in the log of changes \log_i , noted $\log_i - \{\omega_i\}$, is defined by the set-theoretic complement such that $\log_i - \{\omega_i\} = \{x \in \log_i \mid x \neq \{\omega_i\}\}$.

