Content-Driven Change Discovery and Impact Determination in Evolving Ontologies

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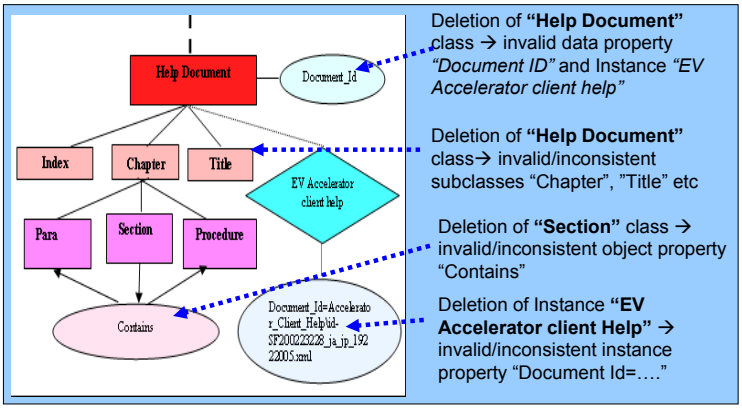
Introduction:

Ontology change occurs whenever there is a change in the domain, the conceptualization or the representation. The changes sometimes originate from an ontology engineer with explicit change requests or as a result of content changes to which ontologies are linked in order to support content management and access. These changes have impacts on the structure (taxonomy) and the semantics (content meaning) of the target and all dependent ontologies. However, the impact of the changes are not fully visible to the content engineer at the time of change implementation when applied to a relatively large ontology. Thus, determining the impacts of the changes on the target ontology and presenting them in understandable way to the engineer before the implementation takes place needs to be addressed.

Content-driven changes and impacts:

In order to make ontologies timely, the content engineer needs to carry out the necessary changes that are performed on an ontology, which can impact on content and dependent ontologies. Implementing all the requested changes without analyzing their impacts prior to the implementation may result in structural and semantic inconsistency and invalidate elements of the ontology.

The following diagram illustrates the structural impacts of change operations. The content engineer requests the deletion of the concept "Help Document" from the ontology. Deleting the "Help Document" class has direct and cascaded impacts on the target and dependent ontologies.



Deletion of **"Help Document"** class → invalid data property *"Document ID"* and Instance *"EV Accelerator client help"*

Deletion of **"Help Document"** class→ invalid/inconsistent subclasses "Chapter", "Title" etc

Deletion of **"Section"** class → invalid/inconsistent object property "Contains"

Deletion of Instance **"EV Accelerator client Help"** → invalid/inconsistent instance property "Document Id=…."

➢In a relatively large ontology, identifying the impacts of the requested changes manually become very complex and some times difficult.

➢ Due to this, an automated or semi-automated solution to analyse and represent the impact of change operations before the changes are implemented is of paramount importance.

Change discovery and impact determination model:

Change request discovery:

Detecting changes: the changes originate either from top-down or bottom-up activities:

→ e.g. detecting top-down changes by tracing change requests as soon as they are requested by the content engineer

Impact determination:

Determining impacts : the impacts are either structural or semantic

→ e.g. determining structural impact by analyzing the request and identifying part of the ontology that will be affected by the change.

Validity:

Determining the validity of the remaining ontology based on the change operation. Validity can be either structural or semantic validity

→ structural validity with respect to entities, properties, and instances

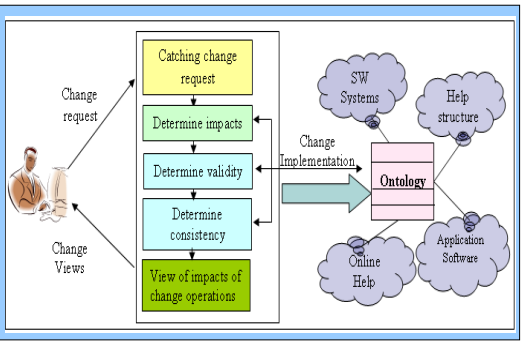
Consistency :

Determining the consistency of the ontology against the rules and constraints of the domain area in relation to the strategies followed by to maintain consistency.

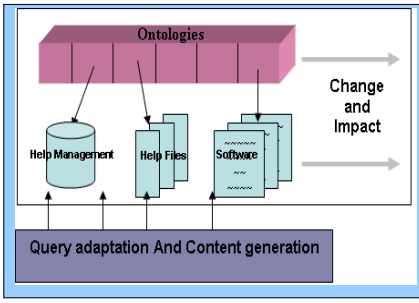
→ determining the consistency of the ontology in relation to the constraints

➢The model enables the content engineer to see the impacts of his/her changes on the ontology before s/he implements the changes permanently.

➢This enables her/him to visualize which part of the ontology will be affected by the change and what kind of consistency and validity measures s/he should take.



Demonstrator application:



The ontology evolves through time. Still, it needs to support the management and adaptation of users queries referring to content.

The ontology also evolves whenever new content is generated and respective information is added to any of the ontologies within the framework.

Evaluation:

The solutions are measured in terms of their adequacy, validity and consistency of resulting ontology with respect to underlying content. Completeness is another evaluation criterion.

References:

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