

On the Feasibility of Ontology Debugging via Model Generation

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What Ontologies are – Example

Pizza Ontology

$\forall hasTopping. VegetarianTopping \sqsubseteq VegetarianPizza$

$MozzarellaTopping \sqsubseteq VegetarianTopping$

$TomatoTopping \sqsubseteq VegetarianTopping$

$Margherita \sqsubseteq \forall hasTopping. (MozzarellaTopping \sqcup TomatoTopping)$

$Margherita \sqsubseteq \exists hasTopping. MozzarellaTopping$

$Margherita \sqsubseteq \exists hasTopping. TomatoTopping$

\vdots

Reasoning on the ontology allows us to derive implicit information such as

$Margherita \sqsubseteq VegetarianPizza$

Ontology Debugging – Underspecification

Pizza Ontology

$\forall \text{hasTopping}. \text{VegetarianTopping} \sqsubseteq \text{VegetarianPizza}$

$\text{MozzarellaTopping} \sqsubseteq \text{VegetarianTopping}$

~~$\text{TomatoTopping} \sqsubseteq \text{VegetarianTopping}$~~

$\text{Margherita} \sqsubseteq \forall \text{hasTopping}. (\text{MozzarellaTopping} \sqcup \text{TomatoTopping})$

$\text{Margherita} \sqsubseteq \exists \text{hasTopping}. \text{MozzarellaTopping}$

$\text{Margherita} \sqsubseteq \exists \text{hasTopping}. \text{TomatoTopping}$

⋮

It is no longer true that $\text{Margherita} \sqsubseteq \text{VegetarianPizza}$

Our Approach

Use model generation as tests in test-driven software development.

Given an ontology \mathcal{O} and a set S_α of properties, check if $\mathcal{O} \models \alpha$ ($\mathcal{O} \cup \{\neg\alpha\} \models \perp$) for all $\alpha \in S_\alpha$.

- if $\mathcal{O} \not\models \alpha$
 - extraction of a model where $\neg\alpha$ is true
 - the model is an explanation of why $\mathcal{O} \not\models \alpha$
 - understanding the model allows to fix the ontology
- if $\mathcal{O} \models \alpha$ then \mathcal{O} is well specified w.r.t. α

Applicable at any stage of the life cycle of an ontology.

Our Approach – Example

Pizza Ontology

$\forall hasTopping. VegetarianTopping \sqsubseteq VegetarianPizza$

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~~$TomatoTopping \sqsubseteq VegetarianTopping$~~

$Margherita \sqsubseteq \forall hasTopping. (MozzarellaTopping \sqcup TomatoTopping)$

$Margherita \sqsubseteq \exists hasTopping. MozzarellaTopping$

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⋮

Check $\mathcal{O} \cup \{(Margherita \sqcap \neg VegetarianPizza)(a)\} \models \perp$

