Combining SHACL and Ontologies

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1. Problem

OWL and SHACL are two prominent W3C standards for handling RDF data on the Web.

OWL
- reason with implicit knowledge
- open-world assumption: not all true data must be present

SHACL
- check correctness of data
- closed-world assumption: if the information is not there, it is not true

- combination mentioned in SHACL specification
- feels natural: validation of data with implicit knowledge
- challenging: how to combine open- and closed-world?

Problem Statement

What happens when we combine SHACL and OWL? Can we define working semantics for meaningful fragments? What is the complexity of these semantics? What can we say about containment of SHACL when we have ontologies?

2. First Results

(1) We translated original data and ontological knowledge (DL-Lite) into an austere canonical model, then checked constraints there.

(2) Rewriting the constraints with the ontological knowledge such that they can be directly applied on the original data.

(1) Data

(2) Data

Validating data with stratified, simplified constraints under ontological knowledge (DL-Lite) is EXPTIME-complete in combined complexity.

3. Future Research

Extend our rewriting, to capture:

- complex path expressions
- counting paths

Work with more expressive Description Logics:

$\mathcal{ELHI}, \text{Horn-SHIQ}, \ldots$

What to do with SHACL with unstratified negation?

Deciding containment in fragments of SHACL with ontologies:

Given $\astar$ and $\sstar$ sets of constraints, then $\astar \Rightarrow \sstar$ implies

Particularly hard to find decidable fragment: two kinds of recursion involved.

Non-monotonicity: adding more facts can change validation result - checking over all possible models is not a good idea!

Does $\text{hasWingedPet}$ has the shape of a pet owner?

PetOwnerShape $\leftarrow \exists \text{hasPet}$

ABox

$\text{hasWingedPet} \sqsubseteq \exists \text{hasPet}$

$\exists \text{hasWingedPet} \subseteq \text{Bird}$

$\ldots$

TBox

DL-Lite$_R$

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