

Reconciling SHACL and Ontologies: Semantics and validation via Rewriting

Shqiponja Ahmetaj, Magdalena Ortiz, Anouk Oudshoorn, Mantas Šimkus



OWL

- implicit knowledge
- open-world assumption



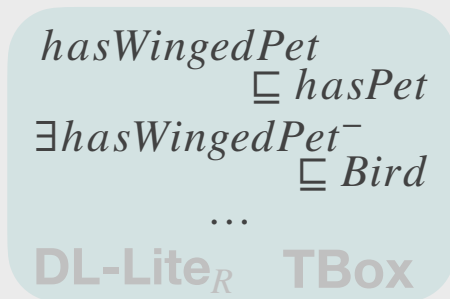
SHACL

- check correctness of data
- closed-world assumption



- combination mentioned in **SHACL specification** (W3C)
- challenging: how to combine open- and closed-world?
- feels natural: validation of data with **implicit knowledge**

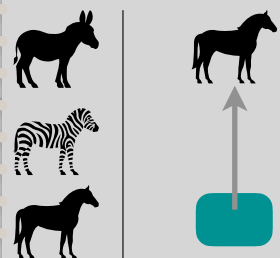
petOwnerShape $\leftarrow \exists hasPet$



\mathcal{T}

Does has the shape of a pet owner?

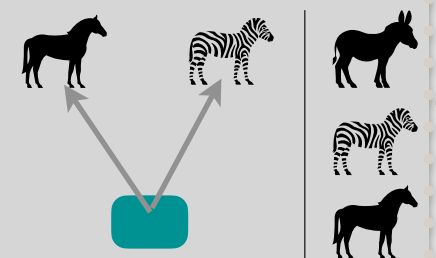
horseShape $\leftarrow \exists hasParent . horseShape \wedge \neg \exists hasParent . (Donkey \vee Zebra)$



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

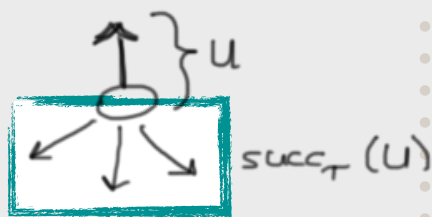
Shapes graph: $(\mathcal{C}, \mathcal{G})$ consists of constraints \mathcal{C} and targets \mathcal{G} : horseShape()

horseShape $\leftarrow Horse$

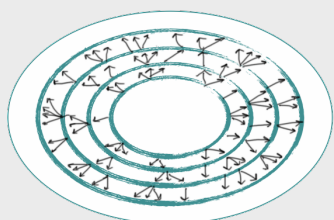


3. Validation

(1a) **Good successor configuration:** local computation of **least** amount of needed successors, based on the TBox — no merging of arrows without cause.



1b) Layer-by-layer construct **austere canonical model** based on $succ_{\mathcal{T}}(U)$ as building blocks.

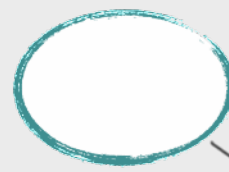


- * Each layer is a core.
- * If core chase exists — coincides with austere canonical model

(1c) **SHACL Validation:** least fixed point computation of shapes over austere canonical model. We write

$(\mathcal{T}, \mathcal{A})$ validates $(\mathcal{C}, \mathcal{G})$.

4. Rewriting



(2a) **Determines** the whole tree below — we can **calculate** which shape names will be assigned to which (grand)*children of this node.

$(\mathcal{T}, \mathcal{A})$ validates $(\mathcal{C}, \mathcal{G})$ iff \mathcal{A} validates $(\mathcal{C}_{\mathcal{T}}, \mathcal{G})$

\mathcal{C}

birdShape $\leftarrow Bird$
birdOwnerShape $\leftarrow \exists hasPet . birdShape$

$\mathcal{C}_{\mathcal{T}}$

birdShape $\leftarrow \exists hasWingedPet^-$
birdOwnerShape $\leftarrow \exists hasWingedPet$

5. Future Work

- 1) Include other SHACL features, 2) More expressive DLs: ELHI, Horn-SHIQ, ..., 3) SHACL with unstratified negation