

Knowledge Representation and Semantic Technologies

# **Exercises on OWL 2 profiles**

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# Exercise 1

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Given the following TBox:

- (1) MALE  $\sqsubseteq$  PERSON
- (2) FEMALE  $\sqsubseteq$  PERSON
- (3) hasMother  $\sqsubseteq$  hasParent
- (4) hasFather  $\sqsubseteq$  hasParent
- (5) hasChild  $\sqsubseteq$  hasParent<sup>-</sup>
- (6) MALE  $\sqcap$  FEMALE  $\sqsubseteq \perp$
- (7)  $\exists$ hasParent  $\sqsubseteq$  IS-CHILD
- (8) IS-CHILD  $\sqsubseteq$   $\exists$ hasParent
- (9)  $\exists$ hasParent.HAPPY  $\sqsubseteq$  HAPPY-CHILD
- (10)  $\exists$ hasChild.HAPPY  $\sqsubseteq$  HAPPY-PARENT
- (11) HAPPY-CHILD  $\sqsubseteq$   $\exists$ hasParent
- (12) HAPPY-PARENT  $\sqsubseteq$   $\exists$ hasChild
- (13) HAPPY-PARENT  $\sqcap$  HAPPY-CHILD  $\sqsubseteq$  HAPPY

# Exercise 1

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- (a) Tell which of these axioms can be expressed in  $\text{DL-Lite}_R$ , EL, and RL, respectively;

# Exercise 1

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(b) given the following ABox:

MALE(Bob), MALE(Paul), FEMALE(Ann), hasMother(Paul,Ann),  
hasFather(Mary,Paul), hasChild(Jane,Paul), hasChild(Jane,Bob),  
HAPPY(Ann)

and the TBox obtained from the previous one by discarding the axioms not expressible in RL, determine the instances of the concept HAPPY by applying forward chaining;

(c) Given the above ABox and the TBox obtained from the previous one by discarding the axioms not expressible in  $DL\_Lite_R$ : (c1) determine the instances of the concept HAPPY by applying query rewriting; (c2) determine the instances of the query  $q(x) :- \text{hasParent}(x,y)$  by applying query rewriting.

# Exercise 1(a): Solution

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The axioms expressible in  $DL\_Lite_R$  are:

(1), (2), (3), (4), (5), (6), (7), (8), (11), (12)

Notice that axiom (6) can be expressed in  $DL\_Lite_R$  by the equivalent axiom  $MALE \sqsubseteq \neg FEMALE$

The axioms expressible in  $EL$  are:

(1), (2), (7), (8), (9), (10), (11), (12), (13)

The axioms expressible in  $RL$  are:

(1), (2), (3), (4), (5), (6), (7), (9), (10), (13)

# Exercise 1(b): Solution

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The ABox obtained by chasing the initial ABox with the RL axioms of the TBox is the following:

MALE(Bob), MALE(Paul), FEMALE(Ann), hasMother(Paul,Ann),  
hasFather(Mary,Paul), hasChild(Jane,Paul), hasChild(Jane,Bob),  
HAPPY(Ann), HAPPY(Mary),  
PERSON(Bob), PERSON(Paul), PERSON(Ann), hasParent(Paul,Ann),  
hasParent(Mary,Paul), hasParent(Paul,Jane), hasParent(Bob,Jane),  
IS-CHILD(Paul), IS-CHILD(Mary), IS-CHILD(Jane),  
HAPPY-CHILD(Paul), HAPPY-PARENT(Paul), HAPPY(Paul),  
HAPPY-PARENT(Ann), HAPPY-CHILD(Mary), HAPPY-PARENT(Jane)

The instances of concept HAPPY are therefore {Ann, Mary, Paul}.

# Exercise 1(c1): Solution

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The rewriting of the query

$q(x) :- \text{HAPPY}(x)$

w.r.t. the DL-LiteR axioms of the TBox is simply:

$q(x) :- \text{HAPPY}(x)$

since there are no subconcepts of HAPPY (notice that axiom (13) is not a DL-LiteR axiom, hence it is ignored).

By evaluating such a query on the initial ABox, we obtain the answers {Ann, Mary}.

# Exercise 1(c2): Solution

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The rewriting of the query

$q(x) \text{ :- hasParent}(x,y)$

w.r.t. the DL-LiteR axioms of the TBox is simply:

$q(x) \text{ :- hasParent}(x,y)$

$q(x) \text{ :- hasMother}(x,y)$

$q(x) \text{ :- hasFather}(x,y)$

$q(x) \text{ :- hasChild}(y,x)$

$q(x) \text{ :- IS-CHILD}(x)$

$q(x) \text{ :- HAPPY-CHILD}(x)$

By evaluating such a query on the initial ABox, we obtain the answers {Paul, Mary, Bob}.