

Tutorial 2: Description Logics

Week 4

1. Formulate ALC concepts: for each of the following concepts, build a suitable ALC concept description, using only the concept names: Person, Happy, Animal, Cat, Old, Fish, and the role name owns.

- a. happy person
- b. happy pet owner
- c. person who owns only cats
- d. unhappy pet owners who own an old cat
- e. pet owners who only own cats and fish

2. Which of the following statements is true?

1. $A \sqcap \neg A$ is subsumed by B
2. B is subsumed by $A \sqcup \neg A$
3. $A \sqcap \exists r.B$ is subsumed by $A \sqcap \exists r.\top$
4. $A \sqcap \exists r.(B \sqcap C)$ is subsumed by $A \sqcap \exists r.B$
5. $A \sqcap \exists r.(B \sqcup C)$ is subsumed by $A \sqcap \exists r.B$
6. $A \sqcap \forall r.B$ is subsumed by $A \sqcap \exists r.B$
7. $A \sqcap \exists r.B$ is subsumed by $A \sqcap \forall r.B$
8. $A \sqcap \exists r.A \sqcap \forall r.B$ is subsumed by $A \sqcap \exists r.B$

3. Consider the following ontology \mathcal{O} (schema or a knowledge graph), which consists of the following set of axioms:

$\text{Person} \sqsubseteq \top$
 $\text{Man} \sqsubseteq \text{Person}$
 $\text{Woman} \equiv \text{Person} \sqcap \neg \text{Man}$
 $\text{Parent} \equiv \text{Person} \sqcap \exists \text{hasChild}.\text{Person}$
 $\text{Father} \equiv \text{Man} \sqcap \text{Parent}$
 $\text{Mother} \equiv \text{Woman} \sqcap \text{Parent}$
 $\text{TwoChildrenFather} \equiv \text{Father} \sqcap \geq 2\text{hasChild} \sqcap \leq 2\text{hasChild}$
 $\text{HappyFather} \equiv \text{Father} \sqcap \exists \text{hasChild}.\text{Man} \sqcap \exists \text{hasChild}.\text{Woman}$
 $\text{TiredParent} \equiv \text{Parent} \sqcap \geq 5\text{hasChild}$
 $\text{hasChild} \sqsubseteq \text{hasDescendant}$
 $\text{Trans}(\text{hasDescendant})$
 $\text{hasAncestor} \sqsubseteq \text{hasDescendant}$
 $\text{John} : \text{Man}$
 $\text{Mary} : \text{Woman}$
 $\langle \text{John}, \text{Mary} \rangle : \text{hasChild}$

and the following interpretation $\mathcal{I} = (\Delta^{\mathcal{I}}, \cdot^{\mathcal{I}})$ of \mathcal{O} , where

- $\Delta^{\mathcal{I}} = \{a, b, c, d, e, f, g, h\}$
- $\text{John}^{\mathcal{I}} = a$
- $\text{Mary}^{\mathcal{I}} = b$
- $\text{Person}^{\mathcal{I}} = \{a, b, d, f, g, h\}$
- $\text{Man}^{\mathcal{I}} = \{a, g, h\}$
- $\text{hasChild}^{\mathcal{I}} = \{\langle a, b \rangle, \langle a, h \rangle, \langle b, d \rangle, \langle g, a \rangle, \langle g, f \rangle\}$

Extend to give interpretations to the defined concepts (classes) roles (properties) in the ontology \mathcal{O} , i.e., complete the following:

- $\text{Woman}^{\mathcal{I}} =$
- $\text{Parent}^{\mathcal{I}} =$
- $\text{Father}^{\mathcal{I}} =$
- $\text{Mother}^{\mathcal{I}} =$
- $\text{TwoChildrenFather}^{\mathcal{I}} =$
- $\text{HappyFather}^{\mathcal{I}} =$
- $\text{TiredParent}^{\mathcal{I}} =$
- $\text{hasDecendant}^{\mathcal{I}} =$
- $\text{hasAncestor}^{\mathcal{I}} =$