

Lab session 10: Description logics and ontologies

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1 Interpretations in description logics

Question 1. Let \mathcal{I} be an interpretation. Answer the following questions:

1. How many element does the domain of \mathcal{I} ($\mathcal{D}^{\mathcal{I}}$) have at least?
2. If C is a concept, how many elements can $C^{\mathcal{I}}$ have?
3. If r is a role, how many elements can $r^{\mathcal{I}}$ have?

We consider the following interpretation \mathcal{I} :

- $\mathcal{D}^{\mathcal{I}} = \{e_1, e_2, e_3, e_4\}$
- Concepts:
 - $A^{\mathcal{I}} = \{e_1, e_4\}$
 - $B^{\mathcal{I}} = \{e_1, e_2\}$
 - $C^{\mathcal{I}} = \{e_2, e_3\}$
- Roles:
 - $r^{\mathcal{I}} = \{(e_1, e_1), (e_2, e_4), (e_3, e_1)\}$
 - $s^{\mathcal{I}} = \{(e_2, e_1), (e_3, e_4)\}$

Question 2. For each of the following concepts C , what is the corresponding set $C^{\mathcal{I}}$?

1. $A \sqcup \neg B$
2. $B \sqcap C$
3. $\exists r.B$
4. $\forall s.A$
5. $\exists s.\forall r.\top$

Question 3. Which of the following inclusions is satisfied in \mathcal{I} ?

1. $A \sqcap \neg B \sqsubseteq C$
2. $B \sqcup C \sqsubseteq \exists r.\top$

2 Concepts in \mathcal{ALC} logic

As a reminder, \mathcal{ALC} is the description logic built with the constructors $\sqcup, \sqcap, \neg, \exists, \forall$ (but which does not include $\leq nr.C$ nor $\geq nr.C$).

Question 4. Using the concept names **Person**, **Happy**, **Animal**, **Cat**, **Old**, **Fish** and the role names **owns** and **isOwnedBy**, express the following concepts:

1. happy pet owner
2. person who owns only cats
3. unhappy pet owners who don't own old animals
4. pet owners who own only dogs and fish

Question 5. Using the same concept and role names, express the following axioms:

1. Pet owners are happy
2. Old fish are unhappy
3. Cats are happy if their owner don't own any dog.

3 Building an ontology

This exercise is an open question. There is no perfect answer to this, but I strongly encourage you to give it a try!

Question 6. Propose a simple ontology to describe the university domain. You can choose to describe several elements, such as the professors, students, administration, as well as buildings, courses etc. Propose a few role names, and some axioms, assertions or concept inclusions.

Question 7 (Optional). Using the software Protege (<https://protege.stanford.edu>), implement your developed ontology.