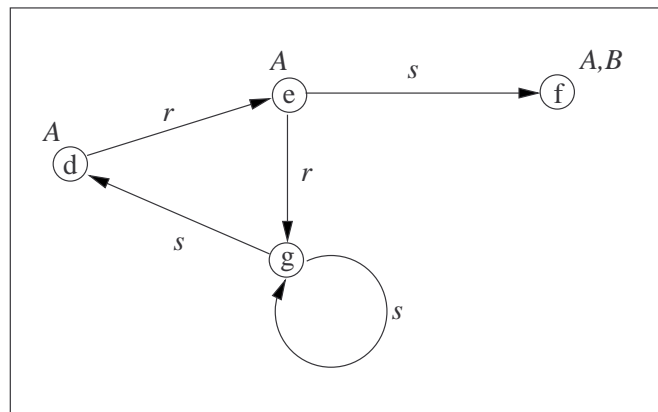


3. Exercises for the Course ‘Description Logics’

Exercise 8:

Consider the (graphical representation of the) interpretation \mathcal{I} with $\Delta^{\mathcal{I}} = \{d, e, f, g\}$:



For each of the following \mathcal{ALC} -concepts C , list all elements x of $\Delta^{\mathcal{I}}$ such that $x \in C^{\mathcal{I}}$:

- (a) $A \sqcup B$
- (b) $\exists s. \neg A$
- (c) $\forall s. A$
- (d) $\exists s. \exists s. \exists s. \exists s. A$
- (e) $\forall t. A \sqcap \forall t. \neg A$
- (f) $\neg \exists r. (\neg A \sqcap \neg B)$
- (g) $\exists s. (A \sqcap \forall s. \neg B) \sqcap \neg \forall r. \exists r. (A \sqcup \neg A)$

Exercise 9:

Recall that the description logic \mathcal{ALC} is equipped with the concept constructors negation (\neg), conjunction (\sqcap), disjunction (\sqcup), existential restriction ($\exists r.C$), and universal restriction ($\forall r.C$). Each subset of this set of constructors gives rise to a fragment of \mathcal{ALC} .

Identify all minimal fragments that are equivalent to \mathcal{ALC} in the sense that for every \mathcal{ALC} -concept, there is an equivalent concept in the fragment.

Two concepts are equivalent iff the concepts have the same extension in every interpretation.

Exercise 10:

Let \mathcal{A} be the ABox consisting of the following assertions:

likes(Ralf, Claudia)	likes(Ralf, Peter)
is-neighbor-of(Claudia, Peter)	is-neighbor-of(Peter, Andrea)
Blond(Claudia)	\neg Blond(Andrea)

- (a) Does \mathcal{A} have a model?
- (b) Is Ralf an instance of the concept $\exists \text{likes} . (\text{Blond} \sqcap \exists \text{is-neighbor-of} . \neg \text{Blond})$ in all models of \mathcal{A} ?
- (c) Is Ralf an instance of the concept $\exists \text{likes} . (\exists \text{is-neighbor-of} . (\forall \text{is-neighbor-of} . \neg \text{Blond}))$ in all models of \mathcal{A} ?

Exercise 11:

This is a practical exercise to get you acquainted with the ontology editor PROTÉGÉ. If not already installed, download PROTÉGÉ 4 from <http://www.co-ode.org/downloads/protege-x/> and install it following the instructions on the web page.

Download the ontology file: **Supermarket.owl** from the DL lecture's web page. Start PROTÉGÉ and load the ontology file. Click on the tab "Classes" to inspect the concepts and click on the tab "Object properties" to inspect the roles in the knowledge base.

- (a) On the "Active ontology" tab on the left in the "Ontology metrics" you can find the diagnosed DL expressivity of the ontology. What concept constructors from the set of \mathcal{ALC} -concept constructors are not used in the TBox?
- (b) Extend the TBox to an \mathcal{ALC} TBox that uses all concept constructors from \mathcal{ALC} by defining new concepts from the supermarket domain.
Hint: The syntax PROTÉGÉ uses is slightly different from the DL one. In PROTÉGÉ existential and value restrictions start with the role name and then the quantor (and then the concept), i.e. "sells all Fruits" vs. $\forall \text{sells} . \text{Fruits}$. To introduce new roles click on the "Object properties" tab.
- (c) Extend your TBox to a knowledge base by an appropriate ABox that uses the concepts from the TBox.

Hint: To create new individuals click on the "Individuals" tab.

Save your ontology file and bring it on an usb stick to the tutorial.