Basics of Description Logic $\mathcal{ALC}$

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1 Understanding $\mathcal{ALC}$

Consider the following $\mathcal{ALC}$ theory $\mathcal{K} = (\mathcal{T}, \{\})$, where $\mathcal{T}$ contains the following axioms:

$$\begin{aligned}
Man &\sqsubseteq Person \\
Woman &\sqsubseteq Person \sqcap \neg Man \\
Father &\equiv Man \sqcap \exists hasChild \cdot Person \\
GrandFather &\equiv \exists hasChild \cdot \exists hasChild \cdot \top \\
Sister &\equiv Person \sqcap \neg Man \sqcap \exists hasSibling \cdot Person
\end{aligned}$$

Ex. 1 — What is the meaning of these axioms ? Do they reflect your understanding of reality ?

Ex. 2 — Consider the following interpretation $\mathcal{I} = (\Delta^{\mathcal{I}}, \bullet^{\mathcal{I}})$:

$$\begin{aligned}
\Delta^{\mathcal{I}} &= Person^{\mathcal{I}} = \{B, A\} \\
Man^{\mathcal{I}} &= \{B\} \\
Woman^{\mathcal{I}} &= \{A\} \\
Father^{\mathcal{I}} &= GrandFather^{\mathcal{I}} = \{B\} \\
hasChild^{\mathcal{I}} &= \{(B, B)\} \\
hasSibling^{\mathcal{I}} &= \{\} \\
Sister^{\mathcal{I}} &= \{B\} \qquad (1)
\end{aligned}$$

1. Is $\mathcal{I}$ a model $\mathcal{K}$? If yes, decide, whether $\mathcal{I}$ reflects reality.
2. We know that $\mathcal{ALC}$ has the *tree model property* and *finite model property.* In case $\mathcal{I}$ is a model, is $\mathcal{I}$ tree-shaped? If not, find a model that is tree-shaped.

Ex. 3 — How does the situation change when we consider $\mathcal{I}_1$ which coincides with $\mathcal{I}$, except that $Sister_1^{\mathcal{I}} = \{\}$?

Ex. 4 — Using the vocabulary from $\mathcal{K}$, define the concept "A father having just sons."

Ex. 5 — Using the vocabulary from $\mathcal{K}$, define the concept "A man who has no brother, but at least one sister with at least one child."

Ex. 6 — During knowledge modeling, it is often necessary to specify:

global domain and range of given role, e.g. "By $hasChild$ (role) we always connect a $Person$ (domain) with another $Person$ (range)".

local range of given role, e.g. "Every father having only sons (domain) can be connected by $hasChild$ (role) just with a Man (range)".

Show, in which way it is possible to model global domain and range of these roles in $\mathcal{ALC}$.

2 Using Protégé

1. Go through the Protégé Crash Course on the tutorial web pages.
2. Create a new ontology in Protégé 4 and insert there all the definitions from Section 1. Verify correctness of your solution of the previous task (e.g. in the DL query tab).

3 Suggested excercise for the semestral work

1. For each of your RDF datasets that are final output of CP1 create a separate ontology describing schema of that data (you will need to use TBox axioms mostly).
2. Modify each of your RDF datasets to include statement importing related schema created in previous task. Hint: use *owl:imports*.
3. Create an ontology that imports all your datasets.
4. Open the ontology of all datasets in Protege to browse all your data.