192.067 VO Deductive Databases
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1.) Consider the following two databases:

$$D_1 = \{PartOf(b, a), PartOf(c, a), PartOf(d, b)\}$$

$$D_2 = \{PartOf(a, b), PartOf(b, a)\}$$

Furthermore, consider the program P consisting of the following two rules:

$$Contains(X, Y) \leftarrow PartOf(Y, X)$$

$$Contains(X, Z) \leftarrow Contains(X, Y), PartOf(Z, Y)$$

Compute the answer to the Datalog query (P, *Contains*) over the database D_1.

Compute the answer to the Datalog query (P, *Contains*) over the database D_2.

(12 points)

2.) Consider a program P consisting of the following three rules:

$$b \leftarrow not\ a$$
$$a \leftarrow b$$
$$a \leftarrow not\ b$$

Present at least one stable model of P. Justify your answer (including the computation of the program reduct). (7 points)

Which of the three rules should be deleted from P so that the resulting program P' has exactly two stable models? Explain you answer. (5 points)

(12 points)

3.) Consider a program P consisting of the following rules:

$$
\begin{aligned}
a &\leftarrow b, \mathit{not}\ c \\
c &\leftarrow \mathit{not}\ a \\
b &\leftarrow a
\end{aligned}
$$

Present a set U_1 of atoms from P such that U_1 is unfounded w.r.t. $(P, \{\}, \{\})$.

Present a set U_2 of atoms from P such that U_2 is unfounded w.r.t. $(P, \{a\}, \{\})$. It should be the case that $U_1 \neq U_2$.

Justify your answer. **(12 points)**

4.) Consider an interpretation $\mathcal{I} = (\Delta^{\mathcal{I}}, \cdot^{\mathcal{I}})$ satisfying the following:

- $\Delta^{\mathcal{I}} = \{a, b, c\}$,
- $A^{\mathcal{I}} = \{a\}$ for the concept name A,
- $B^{\mathcal{I}} = \{b, c\}$ for the concept name B,
- $R^{\mathcal{I}} = \{(b, b), (a, b)\}$ for the role name R, and
- $P^{\mathcal{I}} = \{(a, a), (b, b)\}$ for the role name P.

Compute the extension of $\cdot^{\mathcal{I}}$ for the following complex concepts (i.e. compute $C^{\mathcal{I}}$ for all complex concepts C listed below):

(1) $A \sqcup \neg B$

(2) $\neg A \sqcap (A \sqcup B)$

(3) $\exists R.B$

(4) $\forall R.B$

(5) $\exists P.(A \sqcup \neg A)$

(6) $\forall R.(A \sqcap \neg A)$

(12 points)

5.) By defining a suitable interpretation, show that the concept $A \sqcap (\exists R.B) \sqcap (\forall R.C)$ is satisfiable. Here A, B, C are concept names and R is a role name. **(12 points)**

Grading scheme: 0–31 nicht genügend, 32–38 genügend, 39–45 befriedigend, 46–52 gut, 53–60 sehr gut