

## Deductive Databases & Knowledge Based Systems

### Sheet 3

This exercise is completely optional. If you want any corrections, feel free to hand in your solutions on **paper** into the mailbox at the IFIS floor (Mühlenpfordtstraße 23, 2<sup>nd</sup> floor, opposite of elevator). You may answer in either German or English.

#### Exercise 1

Please answer briefly, no novel-writing!

1. Explain **unsatisfiable**, **satisfiable**, **universal**. (3 points)
2. What is a **model**? What is a **tautology**? (2 points)
3. What is a semantic **conclusion**? What is semantic **equivalence**? (2 points)
4. What is an **axiom**? (1 point)
5. What is a **clause**? What is a Horn **clause**? (2 points)
6. What is special about the **Herbrand interpretation**? (3 points)

#### Exercise 2

1. Prove using the introduced **Hilbert-style** proof system following statement. (7 points)
  - a.  $\models A \rightarrow A$
  - b.  $\models (A \rightarrow B) \rightarrow ((B \rightarrow C) \rightarrow (A \rightarrow C))$
  - c.  $\models B \rightarrow ((B \rightarrow A) \rightarrow A)$
2. Can the following formulas be written **clauses**? If so, **provide** the corresponding clause. Is it also a Horn clause? (5 points)
  - a.  $A \rightarrow ((B \wedge C) \rightarrow D)$
  - b.  $(A \vee B \vee C) \rightarrow D$
  - c.  $(\neg A) \rightarrow (\neg B)$
  - d.  $(\neg A) \rightarrow C$
  - e.  $B \wedge (C \vee D)$

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3. Which of the following Hilbert interpretation for the language

$\mathcal{L} := \{\{a, b, c\}, \{f, g\}, \{p, q\}, \{ \ \}\}$  is also a **Herbrand** model the formulas  $\mathcal{W} := \{(p(a) \rightarrow p(b) \wedge p(b) \rightarrow p(c)) \rightarrow (p(a) \rightarrow p(c)), (p(a) \rightarrow p(b)) \rightarrow (p(b) \rightarrow p(a))\}$ ? (3 points)

- $I := \{p(a) \rightarrow p(b), p(b) \rightarrow p(c), p(a) \rightarrow p(c)\}$
- $I := \{p(a) \rightarrow p(b), p(b) \rightarrow p(a)\}$
- $I := \{p(a) \rightarrow p(b), p(a) \rightarrow p(c)\}$