

## Deductive Databases & Knowledge Based Systems

### Sheet 3 (until 21.11.2008)

Please note that you need **50%** of all exercise points to be admitted for the final exams. Exercises have to be turned in until **Tuesday** before the next lecture and should be completed in teams of two students each. Write both names and “Matrikelnummer” on each page. If you have multiple pages, staple them together! Please hand in your solutions on **paper** into the mailbox at the IFIS floor (Mühlenpfordtstraße 23, 2<sup>nd</sup> floor, opposite of elevator), or bring it directly to the lecture. 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.  $\vDash A \rightarrow A$
  - b.  $\vDash (A \rightarrow B) \rightarrow ((B \rightarrow C) \rightarrow (A \rightarrow C))$
  - c.  $\vDash B \rightarrow ((B \rightarrow A) \rightarrow A)$
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)

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