Tutorial Artificial Intelligence WS 13/14 Wirtschaftsinformatik und Maschinelles Lernen (ISMLL) Ruth Janning, M.Sc., Carlotta Schatten M.Eng.

## Exercise Sheet 10

Submission: Monday, 27.01.2013, 23:00

## Exercise 1 First-Order-Logic Inference (20 Points)

- a) Propositionalize following sentences with Universal Instantiation and Existential Instantiation. Explain which one you used and why.
  - Students, that party a lot, have worse results but more fun:  $\forall x : (student(x) \land party(x)) \Rightarrow (worseResults(x) \land Fun(x))$  $Vocabulary = \{John, Uwe\}$
  - There are odd numbers and even numbers:  $\forall x : Number(x) \Rightarrow (even(x) \lor odd(x))$  $Vocabulary = \{2, 3\}$
  - Some numbers are also prime numbers:  $\exists x : number(x) \land primeNumber(x)$  $Vocabulary = \{3, 99\}$
  - There is a student that studied with his best friend (BFF) and had a good mark:  $\exists x : student(x) \land StudiedWith(x, BFF) \land GoodMark(x)$  $Vocabulary = \{John, Uwe\}$

(4 Points)

b) Infer with unification about the sentence "X sell Y the object Z" or Sell(x, y, z)

| p                      | q                        | $\theta$ |
|------------------------|--------------------------|----------|
| Sell(x, y, z)          | Sell(x, y, Missile)      | ??       |
| Sell(John, y, z)       | Sell(x, KingRichard, z)  |          |
| Sell(x, y, z)          | Sell(x, y, isMissile(g)) |          |
| Sell(x, Lukas, z)      | Sell(x, Uwe, coffee)     |          |
| Sell(isAdult(b), y, z) | Sell(x, y, isMissile(g)) |          |

(5 Points)

c) "The law says it is a crime for a student to copy during an exam or to give hints to a classmate. Martin has some crib sheets and is whispering to a friend during the exam.

Prove that Martin is a criminal with the Backward Chaining algorithm. (8 Points)

d) Express in CNF following sentences:

- There are odd numbers and even numbers:  $\forall x : Number(x) \Rightarrow (even(x) \lor odd(x))$
- Some numbers are also prime numbers:  $\exists x : number(x) \land primeNumber(x)$

(3 Points)