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MATH. - NATURWISS. FAKULTÄT
FACHBEREICH INFORMATIK
KOGNITIVE SYSTEME · PROF. A. ZELL

Artificial Intelligence

Assignment 11

Assignment due by: 11.02.2022

Question 1 Resolution (3+5=8 Points)

(a) Use **unit resolution** to prove that Eva or Zack were involved in the "hacking case" of the previous assignment (Assignment 10, Question 3). The knowledge base was:

$E \vee N \vee Z \vee M, \quad \neg N \vee Z, \quad \neg N \vee M, \quad \neg E \vee N \vee Z \vee M, \quad \neg M \vee N \vee E \vee Z, \quad \neg N \vee \neg E, \quad \neg M \vee \neg N$

(b) Use **resolution** on the following knowledge base until you found three unit clauses:

$\neg A \vee B, \quad \neg A \vee \neg B \vee \neg W, \quad \neg A \vee \neg B \vee W \vee \neg X, \quad \neg A \vee \neg B \vee W \vee \neg Y, \quad \neg A \vee \neg B \vee W \vee Y,$
$\neg A \vee \neg B \vee W \vee X, \quad A \vee \neg X, \quad X \vee Y$

Question 2 First order logic (5+5+2=12 points)

(a) State which terms in the following assertions are objects, relations or functions. (Note that the term names do not necessarily follow common sense despite their logical correctness)

(i) Sister(Mark) = Fiona

(ii) Son(Marie, Ben) ∧ Female(Marie) ⇒ Mother(Ben, Marie)

(iii) ∀y∃x GoodMatch(y,x) ∧ Single(x) ∧ ¬(x=Grandmother(y))

(iv) Coworker(Student1(Saul), Head(Robo)) ⇒ Student2(Paul)

(v) $A(B(C)) \vee D(E) \Rightarrow F(G) = H(I(J))$

(b) Consider a vocabulary with the following predicate, $Friend(x, y)$: person y is the friend of person x. And the following function, $Age(x)$: the age of the person x. $Names$ are used to denote a person. Use these symbols to write the following assertions in first order logic.

(i) All of Jesse's friends are older than himself.

(ii) Nora and her friend Hannah have the same age.

(iii) If Finn is younger than 6, he is not Miko's friend.

(iv) If somebody is older than 70 and not Dorothea, it has to be Agnes who is 77 years old and a friend of Dorothea.

(v) There is at least one person above 66 who has no friends.

(c) Express the following assertions in common language and point out the difference (make sure the difference becomes clear for somebody who is not trained in logical language).

(i) Friend(x,y): x and y are friends to each other
Enemy(x,y): x and y are enemies to each other

- ∀x∀y Friend(x,y) ⇒ ¬Enemy(x,y)
- ∀x∀y Friend(x,y) ⇔ ¬Enemy(x,y)
- ∀x∀y Friend(x,y) ∧ ¬Enemy(x,y)

(don't forget the task on the next page)

(ii) Loves(x,y): x loves y

- $\exists x \forall y$ Loves(x,y)
- $\forall y \exists x$ Loves(y,x)
- $\forall y \exists x$ Loves(x,y)
- $\exists x \forall y$ Loves(y,x)