

CSE 4/563 Knowledge Representation

Professor Shapiro

Homework 5

Maximum Points: 18 (plus 3 bonus points)

Due: 10:45 AM and 11:00 AM, Wednesday, March 24, 2004

March 8, 2004

1. (15) This question is to be handed in at the beginning of class as hard-copy. You are to produce the hard-copy by hand (writing **neatly**). **Include your name, printed or hand-printed neatly at the top of the paper.**

Notice that 18 points are available for this question, any 3 of which are bonus points.

- (a) For each of the following pairs of atomic formulae, if they unify, show an mgu (most general unifier), otherwise, write “Fail”, and give the reason for failure, such as “ a and $f(b)$ are nonequal ground terms”, or “ x occurs in $f(x)$ ”.
- (3) $P(f(a, x), b, g(x))$ and $P(f(u, h(z)), z, g(w))$.
 - (3) $P(f(a, x), b, g(x))$ and $P(f(u, h(w)), z, g(w))$.
- (b) (3) Draw the semantic tableau to show whether $A \Leftrightarrow (B \vee C), \neg(B \wedge C) \models B \Rightarrow \neg C$, and state whether this is true.
- (c) (3) Draw the semantic tableau to show whether $A \Leftrightarrow (B \vee C), \neg(B \wedge C) \models \neg B \Rightarrow C$, and state whether this is true.
- (d) (3) Show the Fitch-style proof that $\forall x((\exists y P(x, y)) \Rightarrow Q(x)) \vdash \forall x \forall y (P(x, y) \Rightarrow Q(x))$.
- (e) (3) Show the resolution refutation proof that $\forall x \forall y ((F(x) \wedge D(y) \wedge O(x, y)) \Rightarrow B(x, y)), \forall x (F(x) \wedge L(x, V) \Rightarrow \exists y (D(y) \wedge O(x, y))), F(A), L(A, V) \models \exists z B(A, z)$.

For each clause in the proof, say whether it came from an assertion, from the conclusion, or was derived by resolution, and, if the latter, the clauses it came from and the mgu that was used.

2. (3) Express the following as a Prolog program.

```
 $\forall x \forall y [rides(x, y) \wedge flies(y) \Rightarrow airTraveler(x)]$   
 $\forall x \forall y [rides(x, y) \wedge gallops(y) \Rightarrow landTraveler(x)]$   
 $\forall x (hasWings(x) \Rightarrow flies(x))$   
 $\forall x (horse(x) \Rightarrow gallops(x))$   
hasWings(pegasus)  
hasWings(roc)  
horse(seabiscuit)  
horse(pegasus)  
rides(bellerophon, pegasus)  
rides(sinbad, roc)  
rides(red, seabiscuit)
```

Use Prolog to find out if someone is both an *airTraveler* and a *landTraveler*.

Cut and paste your Prolog program and a copy of your Prolog run into a file named *hw5.ext*. **Include your name at the top of the file.** Submit that file by **10:45 AM, Wednesday, March 24, 2004** by executing the Unix command

```
submit_cse463 hw5.ext
```

or

```
submit_cse563 hw5.ext
```

whichever is appropriate for you. The file can be a text file, or produced by some word processing software, but it must be formatted so it is easy to read.