Artificial Intelligence: Solutions to Exercise 6

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1. Unify (if possible) the following terms and give the moste general unification (MGU) and the resulting terms. Here P, Q are predicate symbols, f, g are function symbols and X, Y, Z, U are variables.

   (a) $P(X, f(Y))$, $P(f(Z), U)$

   (b) $P(X, f(X))$, $P(Y, Y)$

   (c) $Q(f(X, Y, Z), f(g(W, W), g(X, X), g(Y, Y)))$, $Q(U, U)$

2. Russell's paradox reads "There is a barber who shaves everyone who does not shave himself." We can write this as

$$\forall X \; Shaves(barber, X) \Leftrightarrow \neg Shaves(X, X)$$

   (a) Transform this into the conjunctive normal form

$$(\neg Shaves(barber, X) \vee \neg Shaves(X, X))$$
$$\wedge (Shaves(barber, X) \vee Shaves(X, X))$$

   (b) Express the statement without the universal quantifier and use an existential quantifier instead.

3. Monitoring safety belt usage.
   In a car, the usage of the safety belt is monitored. The person might even be called by its name to remind her or him of using the safety belt. The monitoring is based on a weight sensor in the seat and a system which checks, whether the safety belt is fastened (i.e. the belt is locked). The triggering of the alarm is described by the following first order predicate logic (PL1) expressions

$$Occupant(Name, Weight, belted) \Rightarrow Alarm(Name, off) \tag{1}$$

$$Occupant(Name, less10kg, belted) \Rightarrow Alarm(Name, off) \tag{2}$$

$$\neg ok(Sensors) \Rightarrow Alarm(Name, off) \tag{3}$$

$$Occupant(Name, more10kg, unbelted) \wedge ok(Sensors) \Rightarrow Alarm(Name, on) \tag{4}$$

The implication (1) means that no alarm is triggered, if the occupant is belted. If the weight is below the minimal weight of $10kg$ (2), or the sensors are not correctly working (3), there will be no alarm. An alarm is triggered if the weight of the occupant is higher than $10kg$ and the occupant is unbelted and the sensors are ok (4).

The following facts are known

- There are two occupants in the car. The known facts about the occupants can be seen in the tabular.

- The sensors in the car are working properly.

Occupant	Name	Weight	Safety belt
1	Karl	more than 10 kg	unbelted
2	Hans	less than 10 kg	belted

(a) Summarize the facts stated above as clauses in PL1 using the predicated defined in Eqs. (1)-(4).

(b) Summarize the facts and the definitions in Eqs. (1)-(4) to set of axioms. The axioms should be clauses.

(c) Use resolutional calculus to proof that the alarm was triggerd by occupant Karl.