CS 2800: Lab Assignment 6(Will be graded)

15 October 2010

1. **Apply a substitution**
   Below you are given a set of ACL2 terms and substitutions. Recall that a substitution is a list of 2-element lists. For example, the substitution `((l (cons h t)) (x z))` maps `l` to `(cons h t)` and `x` to `z`. For each term/substitution pair below, show what you get when you apply the substitution to the term (i.e. , when you *instantiate* the term using the given substitution). Basically given ϕ and σ find $\phi|_\sigma$.
   Example Problem: ϕ: `(rev y)` σ: `((y (cons x l)))`
   Solution: $\phi|_\sigma$: `(rev (cons x l))`

   (a) ϕ: `(true-listp x)`
   σ: `((x (cons y z)) (w z))`

   (b) ϕ: `(cons x1 l2)`
   σ: `((x1 (cons x2 l2)) (l2 (app l21 l22)))`

   (c) ϕ:`(app (cons x y) (app z w))`
   σ: `((y (cons a (cons b nil))) (w (app a b)))`

   (d) ϕ: `(rev-tail l (cons a acc))`
   σ: `((l (app a l)) (acc (cons d e)))`

2. **Find a Substitution**
   For each pair of ACL2 terms, give a substitution that instantiates the first to the second. i.e. given ϕ and ψ, find σ such that $\psi =_s \phi|_\sigma$. If no such σ exists, say so:
   Example Problem1:
   ϕ `(set-union a b)`
   ψ: `(set-union a (cons c a))`
   Solution: σ: `((b (cons c a)))`
   Example Problem2:
   ϕ `(set-union (rev a) b)`
   ψ: `(set-union y (cons c a))`
   Solution: No σ exists. Basically there is no way you can instantiate ϕ to get ψ.

   (a) ϕ: `(equal (consp (app x y)) (consp y))`
   ψ: `(equal (consp (app (cons h t) 42)) (consp 42))`
   (b) ϕ: `(app A (app B (rev C)))`
   ψ: `(app (cons a B) (app A (rev (cons 2 A))))`
   (c) ϕ: `(union-equal (cons z w) (cons y nil))`
   ψ: `(union-equal (cons z z) (cons y x))`
   (d) ϕ: `(app (rev l) (rev (cons a l)))`
   ψ: `(app (rev (cons a b)) (rev (cons (+ 1 a) (cons b a))))`

Note: $=_s$ refers to syntactic equality. That is if $A =_s B$ is true, then that means, that A and B stand for exactly the same sequence of symbols.