CSCE 4430 Programming Languages, Spring 2015

Exam 1, March 26, 2:30am-3:40pm, 25 points

Answer question 0 (1 point)

In one short paragraph, describe what you consider the most annoying feature for each of the Prolog and Haskell programming languages.

Answer 2 out of the following 3 questions, for 12 points each.

Question 1 (12 points)

We define de Bruijn terms as given by the Haskell data type:

```haskell
data Term = Var Int | App Term Term | Lam Term deriving (Eq,Show,Read)
```

Write a Haskell Function that encodes each term as a list of binary digits based on the following rules:

- a variable Var i is encoded as i 1-digits followed by a 0 digit
- an application App x y is encoded as two 0-digits followed by the encoding of x and then the encoding of y
- a lambda term Lam x is encoded as 0,1 followed by the encoding of x

For example, the encoding of

- Lam (Var 0) gives [0,1,0]
- Lam (App (Var 0) (Var 1)) gives [0,1,0,0,0,1,0]
- Lam (Lam (Lam (App (Var 1) (App (Var 2) (Var 0))))) gives [0,1,0,1,0,1,0,0,1,0,0,0,1,1,0,0,1,0,0].

Question 2 (12 points)

A binary tree has leaves labeled with the integers 1,2,4,...,n. Write a Prolog or Haskell program that creates a new binary tree with the leaves labeled with n,n-1,n-2,...,1.

Question 3 (12 points)

Without using any library functions, write a Prolog predicate subst that replaces the first occurrence of a sublist of a list with another list, and leaves the list unchanged if it does not find the sublist in it. An example of use would be the following:

```
?-subst([1,2,3,4,3,2,1,2,3,4,5],[2,3,4],[20,30,40],Res).
Res = [1,20,30,40,3,2,1,2,3,4,5].
```