Declarative Programming

Example exam

1. (2+2)

   a) Please define a function (`delete x l`), whose value is the list `l` without the first occurrence of `x`.

   b) Please define a function (`count x l`), whose value is the number of occurrences of `x` in list `l`.

2. (2+2)

   a) Please define a function (`filter pred l`) for a one-argument predicate `pred`, whose value is the list containing all element of the list `l` fulfilling `pred`. Examples:

   ```
   > (filter even '(4 3 5 6))
   '(4 6)
   > (filter list? '((4 3) 7 (1 2 3) 10))
   '((4 3) (1 2 3))
   ```

   b) Suppose binary trees are represented as lists

   ```
               (element left-subtree right-subtree)
   ```

   The empty tree is represented by the empty list. Please define a function `inorder t` for a binary tree in the above representation, whose value is the list of elements of `t` in inorder. Example:

   ```
   > (inorder '(4
               (3 () ())
               (2 (9 () ()) (7 () ()))))
   '(3 4 9 2 7)
   ```

3. (3) Suppose the following definitions are given.

```
(define a 2)
(define (p a)
   (define (pp b)
      (set! a (* 2 b))
      (+ a b))
   (pp 2))
```

Using the environment model please show how the expression (`p 3`) is evaluated.

4. (2+2)

   a) Please define a predicate `member2(X,L)`, that is fulfilled if the element `X` appears at lest two times in the list `L`.

   b) Please define a predicate `down(N,L)`, that is fulfilled if `L` is the list `[N,...0]`.

5. (3) Suppose the following definition of a predicate `append` is given.

```
append([],L,L).
append([X|L1],L2,[X|L3]) :- append(L1,L2,L3).
```

Using answer trees please show how Prolog answers to the query

$$?- \text{append}([1,2],[Z],[1,2,3]).$$