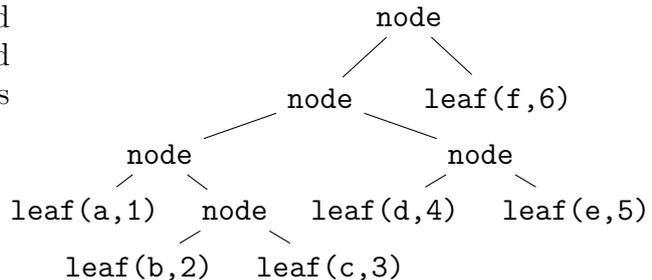


4 Prolog (ijl20)

In your answers ensure each relation has a comment giving a declarative reading of its behaviour. Avoid unnecessary use of *cut* and do not use extra-logical relations such as `findall`, `assertz` and `not (\+)`. Built-in library relations should not be assumed. The Prolog operator in  $A \setminus = B$ , meaning  $A$  will not unify with  $B$ , may be used.

(a) Explain Prolog’s process of *unification*. What situation would an *occurs check* guard against? [3 marks]

(b) Assume `node(Left,Right)` and `leaf(Name,Value)` compound terms are used to represent trees such as:



Define a relation `lookup(+Tree,?Name,?Value)` which finds the value(s) associated with a given name in trees of the above form. [3 marks]

(c) Given a list of atoms,  $L1$ , define a relation `rle(+L1,?L2)` which run-length *encodes*  $L1$  into  $L2$ . For example, `rle([a,a,b,c,a,a,a],L)` should succeed with  $L=[2*a, 1*b, 1*c, 3*a]$ . Giving reasons, indicate for your answer whether a query `rle(L,[2*a, 1*b, 1*c, 3*a])` would succeed with  $L=[a,a,b,c,a,a,a]$ . [5 marks]

(d) Complementary to `rle/2`, define a relation `rld(+L1,?L2)` which *decodes* a run-length-encoded list  $L1$  as defined in part (c) into  $L2$ . [4 marks]

(e) The Prolog relations below, given a query `alter_list([2,4,6],L)`, will succeed with  $L=[a,a,b]$ . Use an additional difference-list argument to accumulate the execution path through the Prolog clauses. Number the clauses 1 to 4 such that `alter_list([2,4,6],L,Path-[])` will succeed with the sequence of clauses as a list of integers in  $Path$ , i.e. with  $L=[a,a,b]$  and  $Path=[4,1,4,1,4,2,3]$ .

```

change(N,a) :- N < 5.
change(N,b) :- N >= 5.
    
```

```

alter_list([], []).
alter_list([H1|T1],[H2|T2]) :- change(H1,H2), alter_list(T1,T2).
    
```

[5 marks]