

Exercises Nov. 14

1. ADAPTED FROM JANUARY 2001, 3

- (a) Write a PROLOG script that “rotates” the elements of a list N positions, e.g., for $N = 2$, the goal

```
?- rotate(2, [a,b,c,d,e,f], X).
```

instantiates X to

```
X = [c,d,e,f,a,b]
```

First, write the script that seems intuitively right to you. Now, consider the running time, for instance by drawing the backtracking tree and making conclusions based on that. If the running time is not linear in the length of the list, write an alternative definition which is.

- (b) Can your script be used for the “inverse” function, i.e., rotate a list N positions in the opposite direction? That is, will the question

```
?- rotate(2, X, [a,b,c,d,e,f]).
```

instantiate Y to

```
Y = [e,f,a,b,c,d]?
```

Explain.

2. ADAPTED FROM JUNE 2006, 2

A merge of two lists is another list containing each element from the two lists exactly once, where the elements of each of the first two lists appear in order (but not necessarily consecutively). As an example, one possible merge of the lists $[a,b,c,d]$ and $[x,y,z]$ is the list $[a,b,x,c,y,z,d]$.

- (a) Implement a PROLOG predicate `merge(L1,L2,L3)` which is true if and only if $L3$ is a merge of $L1$ and $L2$. The predicate must be able to generate (as instantiations of $L3$) all merges of given lists $L1$ and $L2$ by repeated use of `;`.

- (b) In the game of Buzz, players alternate in saying aloud the next positive integer, except that integers divisible by either 3 or 7 (or both) should be replaced by the word “buzz”.

Implement a PROLOG predicate `buzz` which is always true, and where satisfaction of the goal `buzz` as a side effect prints on the screen the infinite sequence `1 2 buzz 4 5 buzz buzz 8 buzz 10 11 buzz 13 buzz buzz...` representing an infinite game of Buzz.

- (c) The Danish version of the game is known as “Bum”, and is slightly different: “buzz” is replaced by “bum”, there is only one divisor d to check for (not two), and integers where d occurs as a digit are also replaced by “bum”. The number d is an integer between 1 and 9, and is decided upon when the game starts.

Implement a PROLOG predicate `bum(D,N,L)` which is true if and only if `L` is the list of the first `N` entries in a game of Bum with digit `D` (where `N` and `D` are assumed to be instantiated). As an example, satisfaction of the goal `bum(3,15,L)` should instantiate `L` to `[1,2,bum,4,5,bum,7,8,bum,10,11,bum,bum,14,bum]`.

3. ADAPTED FROM JUNE 2006, 3

For each of the following pairs of PROLOG predicates, find a most general unifier, or argue that none exists. Explain each step of your derivations.

(a) `q(g(X),X)` and `q(Y,g(Y))`

(b) `s(h(h(X)),h(Y),Z)` and `s(h(h(Y)),h(h(Z)),h(h(T)))`

(c) `X+Y` and `Y+X`

(d) `X*(Y+Z)` and `X*Y + X*Z`