

## 1994 Paper 10 Question 12

### Introduction to Functional Programming

Recall that  $f \circ g$  is the function that maps  $x$  to  $f(g(x))$ . Consider the ML definitions

```
fun I x = x;
fun pair (f,g) (x,y) = (f x, g y);
fun pup (f,g) z = (f z, g z);
fun fst (x,y) = x;
fun snd (x,y) = y;
```

Describe the effect of the following functions:

```
pair(I,I)                pair(f1 o f2, g1 o g2)
pup(fst,snd)            pup(f o fst, g o snd)           [4 marks]
```

Infinite lists can be represented in a functional language by triples. A triple of the form  $(a, h, t)$  represents the infinite list whose  $n$ th element is  $h(t^n(a))$  for  $n \geq 0$ .

- (a) Give a representation for the infinite list  $n, n + 1, n + 2, \dots$  [2 marks]
- (b) Code in ML a map functional for this representation; given a function  $f$  and the infinite list  $x_0, x_1, \dots$ , it should yield the representation of  $f(x_0), f(x_1), \dots$  [3 marks]
- (c) Code in ML a zip function, which combines the infinite lists  $x_0, x_1, \dots$  and  $y_0, y_1, \dots$  to the list of pairs  $(x_0, y_0), (x_1, y_1), \dots$  [4 marks]
- (d) Code in ML an interleave function, which combines the infinite lists  $x_0, x_1, \dots$  and  $y_0, y_1, \dots$  to yield  $x_0, y_0, x_1, y_1, \dots$  [5 marks]
- (e) How does this representation compare with the usual representation of infinite lists in ML? Briefly discuss. [2 marks]