

2007 Paper 1 Question 5

Foundations of Computer Science

(a) Consider the following piece of ML code:

```
datatype 'a tree = Lf | Br of 'a * 'a tree * 'a tree;
exception Blair;

fun tony p Lf = true
  | tony p (Br(x,t1,t2)) = if not (p x) then raise Blair
                          else tony p t1 handle Blair => tony p t2;

fun gordon p t = tony p t handle Blair => false;
```

- (i) Code a function that returns the same results as `gordon` but makes no use of exceptions. [4 marks]
- (ii) What property of binary trees does `gordon` express? [3 marks]
- (b) Write brief notes on the ML type `exn`. [3 marks]
- (c) Consider the following piece of ML code:

```
datatype 'a result = Ian of 'a | Cherie of exn;

fun what f x = Ian (f x) handle e => Cherie e;
```

We ask ML to evaluate the expression

```
map (what (tony (fn x => x <> 0))) [ta,tb]
```

and the response is as follows:

```
val it = [Ian true, Cherie Blair] : bool result list
```

What is the type of `what (tony (fn x => x <> 0))`, and what can we infer about the binary trees `ta` and `tb`? Justify both answers carefully.

[5+5 marks]