

## 2007 Paper 1 Question 6

### Foundations of Computer Science

- (a) Write brief notes on reference types in ML and on control structures for imperative programming. [6 marks]

Consider the following ML datatype:

```
datatype 'a meal = Snack of 'a
                | Lunch of 'a meal * 'a meal
                | Feast of 'a meal * 'a meal * 'a meal;
```

- (b) Write a function that is equivalent to `snacker` below but makes no use of references. Briefly explain why the two functions are equivalent.

```
fun snacker m =
  let val l = ref []
      fun munch (Snack x) = (l := x :: !l)
        | munch (Lunch (m1,m2)) = (munch m1; munch m2)
        | munch (Feast (m1,m2,m3)) =
          (munch m1; munch m2; munch m3)
      in munch m; !l end;
```

[5 marks]

- (c) Write a function `gluttony` such that `gluttony m1 m2` makes a copy of `m1`, replacing every `Snack` node with `m2`. [3 marks]
- (d) Write a function `glut` such that `glut k m1 m2` makes a copy of `m1`, replacing the  $k$ th `Snack` node with `m2`. Nodes are counted from left to right, with the leftmost node being number one. [6 marks]