

COMPUTER SCIENCE TRIPOS Part IA – 2014 – Paper 1

1 Foundations of Computer Science (LCP)

(a) Write brief notes on polymorphism in ML, using lists and standard list functions such as `@` (append) and `map`. [4 marks]

(b) Explain the meaning of the following declaration and describe the corresponding data structure, including the role of polymorphism.

```
datatype 'a se = Void | Unit of 'a | Join of 'a se * 'a se;
```

[4 marks]

(c) Show that ML lists can be represented using this datatype by writing the functions `encode_list` of type `'a list -> 'a se` and `decode_list` of type `'a se -> 'a list`, such that `decode_list (encode_list xs) = xs` for every list `xs`. [3 marks]

(d) Consider the following function declaration:

```
fun cute p Void = false
  | cute p (Unit x) = p x
  | cute p (Join(u,v)) = cute p u orelse cute p v;
```

What does this function do, and what is its type? [4 marks]

(e) Consider the following expression:

```
fn p => cute (cute p)
```

What does it mean, and what is its type? Justify your answer carefully. [5 marks]