

# COMPUTER SCIENCE TRIPOS Part IA – 2010 – Paper 1

## 2 Foundations of Computer Science (LCP)

*This question has been translated from Standard ML to OCaml*

- (a) Write brief notes on the function defined below:

```
let rec fold_left f e = function
  | [] -> e
  | x::xs -> fold_left f (f e x) xs
```

Illustrate your answer by describing the computations performed by the following two functions:

```
let f x = fold_left (fold_left ( * )) 1 x
```

```
let g p zs =
  fold_left
    (fun (x, y) z ->
      if p z then
        (z::x, y)
      else
        (x, z::y))
    ([], []) zs
```

[4 marks]

- (b) Selection sort is a sorting algorithm that works by repeatedly identifying and setting aside the smallest (or largest) item to be sorted. Implement selection sort in OCaml and describe the efficiency of your solution using  $O$ -notation.

[4 marks]

- (c) Code an OCaml function to generate a multiplication table in the form of a list of lists of integers. For example, given the argument 3 it should return  $[[1; 2; 3]; [2; 4; 6]; [3; 6; 9]]$ .

[6 marks]

- (d) Modify your solution to part (c) in order to generate a three-dimensional table containing values  $x_{ijk}$  computed by calling a supplied 3-argument curried function  $f$ . For example, given the argument 2 it should return  $[[[x_{111}; x_{112}]; [x_{121}; x_{122}]]; [[x_{211}; x_{212}]; [x_{221}; x_{222}]]]$ .

[6 marks]

All OCaml code must be explained clearly and should be free of needless complexity.