

2010 Paper 1 Question 2

Foundations of Computer Science

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

```
fun foldl f (e, []) = e
  | foldl f (e, x::xs) = foldl f (f(e,x), xs);
```

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

```
fun f x = foldl (foldl op* ) (1,x);

fun g p zs = foldl (fn ((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 ML and describe the efficiency of your solution using O -notation.

[4 marks]

(c) Code an ML 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 ML code must be explained clearly and should be free of needless complexity.