COMPUTER SCIENCE TRIPOS Part IA − 2015 − Paper 1

1 Foundations of Computer Science (LCP)

(a) Write brief notes about a tree representation of functional arrays, subscripted by positive integers according to their representation in binary notation. How efficient are the lookup and update operations? [6 marks]

(b) Write an ML function `arrayoflist` to convert the list $[x_1, \ldots, x_n]$ to the corresponding functional array having x_i at subscript position i for $i = 1, \ldots, n$. Your function should not call the update operation. [6 marks]

(c) Consider the task of finding out which elements of an array satisfy the predicate `p`, returning the corresponding subscript positions as a list. For example, the list $[2, 3, 6]$ indicates that these three designated array elements, and no others, satisfy `p`. Write an ML functional to do this for a given array and predicate, returning the subscripts in increasing order. [8 marks]

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