

2009 Paper 1 Question 1

Foundations of Computer Science

- (a) The polymorphic curried function `delFirst` takes two arguments, a predicate (Boolean-valued function) `p` and a list `xs`. It returns a list identical to `xs` except that the first element satisfying `p` is omitted; if no such element exists, then it raises an exception. Code this function in ML. [4 marks]
- (b) Use the function `delFirst` to express the polymorphic function `delFirstElt`, where `delFirstElt x xs` returns a list identical to `xs` except that it omits the first occurrence of `x`. [2 marks]
- (c) Carefully explain the polymorphic types of these two functions, paying particular attention to currying and equality. [4 marks]
- (d) A list `ys` is a *permutation* of another list `xs` if `ys` is obtained by rearranging the elements of `xs`. For example, `[2,1,2,1]` is a permutation of `[2,2,1,1]`. Code an ML function to determine whether one list is a permutation of another. [4 marks]
- (e) A list `ys` is a *generalised permutation* of `xs` if `ys` is obtained by rearranging the elements of `xs`, where one element of `xs` is specially treated: it may appear any number of times (including zero) in `ys`. For example, `[1,2,1]` is a generalised permutation of `[1,2]` but `[1,2,2,1]` is not because two elements (1 and 2) appear the wrong number of times in it. Code an ML function to determine whether one list is a generalised permutation of another. [6 marks]

All ML code must be explained clearly.