

1999 Paper 12 Question 10

Introduction to Functional Programming

Define a polymorphic datatype to represent binary trees. [1 mark]

Define a function, `post`, to traverse such a binary tree in post-order. Your function should make use of `@`, the list append function. [2 marks]

Comment on the efficiency of your function `post`, and write a more efficient function, `post2`, which has no occurrences of `@`, the list append function. [2 marks]

Prove using induction that your two functions are equal, i.e.

$$\forall t . \text{post}(t) = \text{post2}(t). \quad [8 \text{ marks}]$$

Define a polymorphic datatype to represent trees where a node may have any number of subtrees. [1 mark]

Define a function, `post3`, to traverse such a tree in post-order. (This function need not be efficient.) [6 marks]