

1998 Paper 1 Question 6

Foundations of Computer Science

What does $O(g(n))$ mean, and what is its relevance to programming? (Describe both advantages and limitations.) [5 marks]

Consider the following ML declarations, for tree-like expressions:

```
datatype 'a expr = Join of 'a expr * 'a expr
                | Tip  of 'a;

fun flatten (Tip x)          = [x]
  | flatten (Join (e1,e2)) = flatten e1 @ flatten e2;
```

The *size* of an expression is the number of `Tip`s it contains. State the complexity of `flatten(e)`, measured in cons operations, as a function of the size of e :

- (a) in the worst case [3 marks]
- (b) in the average case [4 marks]
- (c) in the best case [3 marks]

Code a function `flat` such that `flat(e) = flatten(e)` for all e , justifying this claim. Show that `flat`'s worst-case complexity is linear. [5 marks]