

2002 Paper 1 Question 5

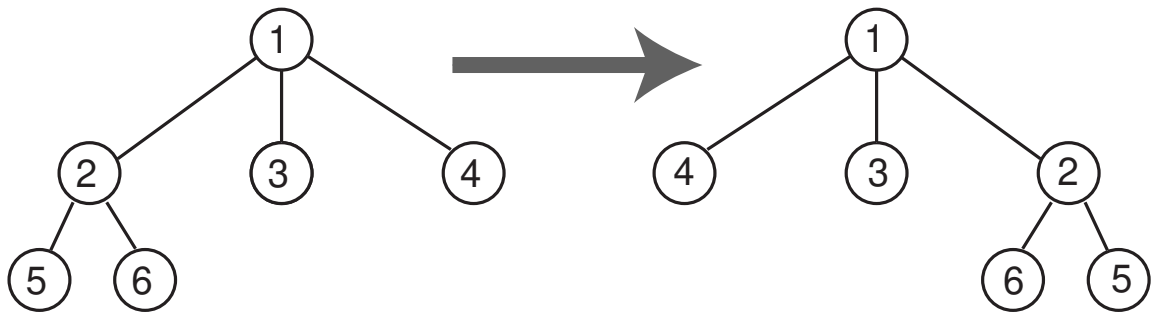
Foundations of Computer Science

This question has been translated from Standard ML to OCaml

This question concerns the following OCaml declaration of a tree type:

```
type 'a fan = Wave of 'a * ('a fan) list
```

- (a) Declare the function `flip`, which maps a tree to a mirror image of itself, as illustrated: [3 marks]



- (b) Declare the curried function `paint f`, which copies a tree while applying the function `f` to each of its labels. [3 marks]
- (c) Declare the function `same_shape`, which compares two trees and returns `true` if they are equal except for the values of their labels and otherwise returns `false`. [5 marks]
- (d) State the types of functions `flip`, `paint` and `same_shape`. [3 marks]
- (e) The function `paper` is declared in terms of the familiar functional `fold_right`:

```
let rec fold_right f l e =
  match l with
  | [] -> e
  | x::xs -> f x (fold_right f xs e)
```

```
let rec paper (Wave(x, fs)) q = fold_right paper fs (q + 1)
```

Describe the computation that results when `paper` is applied to a tree.

[6 marks]