1999 Paper 1 Question 6

Foundations of Computer Science

Describe ML's facilities for treating functions as data, giving examples of their use in programs. Illustrate your answer by discussing the function `foldr`:

```
fun foldr f ([], e) = e
  | foldr f (x::xs, e) = f(x, foldr f (xs,e));
```

[7 marks]

You have been asked to implement a data structure to represent family relationships. For each person, it should record his or her name, mother, father, and children. As a first attempt, you have been given the following `datatype` declaration:

```
datatype person = Person of string * person * person * person list;
```

Identify two problems with this declaration that make it unusable. Modify the declaration to correct these problems. [6 marks]

Consider the following, simpler data structure for associating a person with his or her children:

```
datatype famtree = B of string * famtree list;
```

Write an ML function that takes two arguments: a predicate P over family trees (a function of type `famtree->bool`) and a family tree t. The result should be the list of all subtrees of t (possibly including t itself) satisfying the predicate. For full credit, give due attention to efficiency. [7 marks]