Assignment 2

1. Recall the Shape type:

   ```haskell
data Shape = Rectangle Float Float
      | Ellipse Float Float
```

   This is not self-documenting, since it does not say which parameter is
   the width and which one is the height. Fortunately, there is syntactic
   support for it. Read section 3.15 and possibly 4.2.1 of the Haskell Report
   on labelled fields, and rewrite Shape with labelled fields.

2. Given this declaration of a binary tree type, where each internal node
   bears a piece of data:

   ```haskell
data Tree a = Nil
      | Branch a (Tree a) (Tree a)
```

   write a mapTree function

   ```haskell
mapTree :: (a->b) -> Tree a -> Tree b

mapTree f t returns a new tree t’ that has the same structure as t, but
the data in every node of t’ is obtained from applying f to the data at
the corresponding node in t.
```

3. The emergency room in a hospital is not first-come first-served, for obvious
   reasons; instead, a nurse assesses the condition of every arriving patient
   and assigns him/her a priority number accordingly. Whenever the doctors
   are ready for the next patient, the patient with the smallest priority
   number gets treatment.

   The hospital administration wishes to computerize part of this process to
   aid the nurse. Because of the safety-critical nature of this task, you are
   asked to implement it in Haskell. (Yeah right.) The program lets the nurse
   enter a patient’s name and priority, get the next patient for treatment, and
   close down the program.

   The input consists of a bunch of lines, each being one of these:

   - A Alice 5
     This means a patient Alice has arrived and is assigned priority 5.
     Your program should store the data.
   - N
     This means the doctors are ready and the nurse asks your program
     for the next patient. Your program should output on a line the name
     of the patient to be treated (and remove his/her entry from your
     store.) If there are several patients with the same smallest priority
     number, the one who arrived earliest gets treatment.
• Q
This means the nurse closes down your program. Your program should exit. There are no more input lines after this.

The output is as specified above.

Bonus: you may also like to process this:

• L
The nurse asks your program to list all patients in its store, from the smallest priority to the largest priority. Like in the above, if several patients have the same priority number, order them from the earliest to the latest.

Sample Input:

A Alice 5
A Bob 4
N
A Charles 5
A Dennis 3
N
N
N
Q

Sample Output:

Bob
Dennis
Alice
Charles

To save writing, source code for a leftist heap module, a red-black tree module, and a scheduled queue module will be made available on the web page, and you can use them. Choose the right data structure for simplest coding and best performance!