

Programming Functional

Exercises Week 10

(for December 16, 2016)

1. Prepare for the test!
2. (★) Define a tail-recursive version of the `size` function for trees.
3. (★) Consider the function

```
hanoi :: int -> int -> int -> int -> (int * int) list -> (int * int) list
```

defined by

```
let rec hanoi a b c n xs =  
  if n = 0  
  then xs  
  else hanoi a c b (n-1) ((a,c) :: hanoi b a c (n-1) xs)
```

- a) Evaluate, using equational reasoning,

```
hanoi 1 2 3 2 []
```

- b) Prove by induction that for $n \geq 0$,

$$\text{length (hanoi } a \ b \ c \ n \ xs) = 2^n - 1 + \text{length } xs$$