ASSIGNMENT 2 – HIGHER-ORDER FUNCTIONS

Advanced programming paradigms

In this assignment, you will work with tail recursion and higher-order functions.

Question 1 – *Tail recursion*

(a) Define a tail-recursive version of `fact`

(b) The Fibonacci function is defined as follows:

$$fib(x) = \begin{cases} 0, & \text{if } x = 0 \\ 1, & \text{if } x = 1 \\ fib(x-1) + fib(x-2), & \text{otherwise} \end{cases}$$

You are asked to write two implementation of this function.

1) The first one using the definition above.
2) A second solution using tail recursion. For this one, do not forget to check that your function is tail-recursive with the `@tailrec` annotation[1].

Question 2 – *Higher-order functions*

(a) The `sum` function we defined during the course and that computes

$$\sum_{i=a}^{b} f(x)$$

uses a linear recursion. Can you transform it to a tail recursion by filling the `???` hereafter?

```
1  def sum(f: Int => Int, a: Int, b: Int) = {
2    def iter(a: Int, acc: Int): Int = {
3      if (???) ???
4      else iter(???, ???)
5    }
6    iter(???, ???)
7  }
```

Question 3 – *Currying*

(a) Using the `sum` function as a source of inspiration, write a function `product` that computes the product of the values of a function for the integers in a given interval, i.e.

$$\prod_{i=a}^{b} f(i)$$

Make sure that this function is in its curried form.

(b) Write `factorial` in terms of the function `product` that you defined in part *a*.

(c) Write a more general function that generalizes both `sum` and `product`. This done, provide a new implementation of `sum`, resp. `product`, using that new function.

[1] For which you have to import `scala.annotation.tailrec`