

# Principles for software composition 2024/25

## 04 - Haskell

[Ex. 1] A list is *palindrome* if it is the same when scanned from left to right and from right to left. For example, the strings "noon" and "civic" are palindrome.

Write a Haskell function `pal` that checks if a list is palindrome.

[Ex. 2] Using the function `pal` from Ex. 1, write a Haskell function that takes a list of lists `xxs` and returns the list of palindrome lists in `xxs`.

[Ex. 3] Write a Haskell function `select` that takes a list of integers and returns the list of elements that are followed by its immediate successor. For example, `select [1,2,5,7,3,4]` must evaluate to `[1,3]`.

[Ex. 4] Write a Haskell function `points` that takes a function `f :: Int -> Int` and the extremes of an interval and returns the list of points  $(x, f(x))$  for all the values in the interval.

[Ex. 5] A positive natural number is called *perfect* if it is equal to the sum of its proper positive divisors. For example  $6 = 1+2+3$  and  $28 = 1+2+4+7+14$  are perfect numbers.

Write some Haskell code to generate the list of all perfect numbers.

[Ex. 6] Write some Haskell code that generates the list of Fibonacci numbers.

[Ex. 7] Collatz's chains are built as follows: the chain starts with a positive number: if it is 1 we stop; if it is even we continue the chain dividing it by 2; if it is odd we continue the chain by multiplying it by 3 and adding 1. Examples of Collatz's chains are `[3,10,5,16,8,4,2,1]` and

`[7,22,11,34,17,52,26,13,40,20,10,5,16,8,4,2,1]`.

It is conjectured that for all starting numbers the chains finish at the number 1. Write some Haskell code to compute what is the smallest number whose Collatz's chain has a length greater than 500.

[Ex. 8] Write a Haskell function `evenpos` that extracts the elements in even positions of a list. For example, `evenpos [1,2,5,7,3,4]` must evaluate to `[2,7,4]`.

[Ex. 9] Write a Haskell function `shift` that given a list returns the list obtained by subtracting the minimum of the list from the other elements. The function should only visit the element of the list once. For example, `shift [7,5,3,8]` must evaluate to `[4,2,0,5]`.