

Declarative Programming

Workshop exercises set 5.

QUESTION 1

Define the function

```
maybeApply :: (a -> b) -> Maybe a -> Maybe b
```

that yields `Nothing` when the input `Maybe` is `Nothing`, and applies the supplied function to the content of the `Maybe` when it is `Just` some content.

Try, for example, computing

```
maybeApply (+1) (Just 41)  
maybeApply (+1) Nothing
```

This function is defined in the standard prelude as `fmap`.

QUESTION 2

Define the function

```
zWith :: (a -> b -> c) -> [a] -> [b] -> [c]
```

that constructs a list of the result of applying the first argument to corresponding elements of the two input lists. If the two list arguments are different lengths, the extra elements of the longer one are ignored. For example,

```
zWith (-) [1,4,9,16] [1,2,3,4,5] = [0,2,6,12]
```

This function is defined in the standard library as `'zipWith'`.

QUESTION 3

Define the function

```
linearEqn :: Num a => a -> a -> [a] -> [a]
```

that constructs a list of the result of multiplying each element in the third argument by the first argument, and then adding the second argument. For example,

```
linearEqn 2 1 [1,2,3] = [2*1+1, 2*2+1, 2*3+1] = [3,5,7]
```

Write the simplest definition you can, remembering the material covered recently.

QUESTION 4

The following function takes a number and returns a list containing the positive and negative square roots of the input (assume non-zero input)

```
> sqrtPM :: (Floating a, Ord a) => a -> [a]  
> sqrtPM x  
> | x > 0    = let y = sqrt x in [y, -y]  
> | x == 0    = [0]  
> | otherwise = []
```

Using this function, define a function `allSqrts` that takes a list and returns a list of all the positive and negative square roots of all the numbers on the list. For example:

```
allSqrts [1,4,9] = [1.0,-1.0,2.0,-2.0,3.0,-3.0]
```

Include a type declaration for your function.

QUESTION 5

Lectures have given the definitions of two higher order functions in the Haskell prelude, `filter` and `map`:

```
filter :: (a -> Bool) -> [a] -> [a]
map    :: (a -> b)  -> [a] -> [b]
```

`Filter` returns those elements of its argument list for which the given function returns `True`, while `map` applies the given function to every element of the given list.

Suppose you have a list of numbers, and you want to (a) filter out all the negative numbers, and (b) apply the `sqrt` function to all the remaining integers.

- (a) Write code to accomplish this task using `filter` and `map`.
- (b) Write code to accomplish this task that does only one list traversal, without any higher order functions.
- (c) Transform (b) to (a).