Tutorium Funktionale Programmierung 2019

Part 7 - Type-Synonyms, Tuples, Characters and Strings, let…in and where

VO - Part 3

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Type-Synonyms

type *Point = (Integer, Integer)*

- "is a new name for an existing type"

Tuples

(2, True, 4.0)

- store **multiple values** in a single value
- **fixed** number of elements (*immutable*)
- elements of a tuple do **not need** to be **all of the same type**

where / let…in

```
circumference r = r^2*myPi where myPi = 3.1415

circumference r = let myPi = 3.1415 in r^2*myPi
```

- *for local definitions*
- *not visible outside*

Exercise 7.1.: Type-Synonyms, let…in and show

1. Create a new **type-synonym** **Value** for Double.
2. Create new data types **Dollar** and **Euro using Value**.
3. Create functions to **switch between Dollar and Euro**.
   - **1 EUR = 1.1016 USD**
   - **1 USD = 0.9077 EUR**
4. Create a function for USD which returns the **rounded value (2 decimal places)** **as a String**

   e.g. (USD 1.3234523) ~> (USD 1.32) (use **let…in**)

Strings

“Test” ≡ ['T','e', 's', ' t '] ≡ ['T'] ++ ['e'] ++ “st“ = 'T' :“est“

- type String = [Char] ~> ***is a list of characters***
- ***Useful functions:***

```
head :: [a] -> a
tail :: [a] -> [a]
null :: [a] -> Bool
(++) :: [a] -> [a] -> [a]
[] :: [a]
```

returns first element of list
returns list without first element
test on empty list
append two lists
the empty list

Exercise 7.2: Characters, Tuples, String and where

“In cryptography, a Caesar cipher […] is one of the simplest and most widely known encryption techniques. It is a type of substitution cipher in which each letter in the plaintext is replaced by a letter some fixed number of positions down the alphabet.”

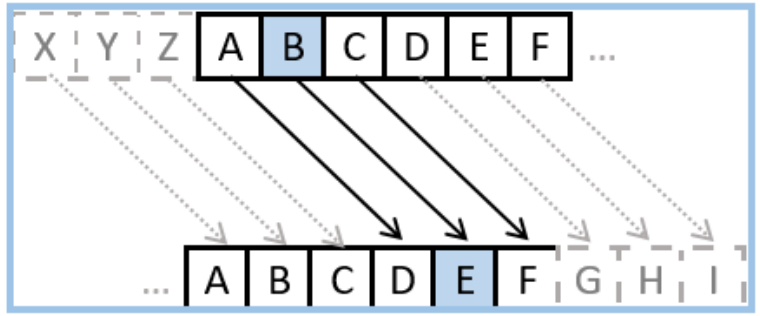
The goal of this exercise is to implement a function *encrypt* that takes as input a *String* (plaintext) in **upper-case-letter** and returns the “shifted *String*” (ciphertext) with Caesar.

The function´s type is

```
encrypt :: (String, Int) -> String
```

plaintext key cyphertext

URL: https://en.wikipedia.org/wiki/Caesar_cipher



SHIFT +3

This Caesar cipher has a shift of 3 characters.

The letter ‘A’ becomes a ‘D’. The letter ‘B’ becomes ‘E’.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C

Plaintext

Ciphertext

e.g. ABC ~> DEF with key 3

Img.: URL: *https://microbit-challenges.readthedocs.io/en/latest/challenges/crypto/caesar.html*

Exercise 7.2: Character, Tuples, String and where CONTINUED

- *be aware of wrong input (exception) e.g. 'a'*
- *to encrypt an ASCI-VALUE use*

  65 + ((m-65) + n) `mod` 26

  m ... ASCI-value (character to encrypt)

  n ... key ∈ ℕ
- *use where*

URL: https://en.wikipedia.org/wiki/Caesar_cipher

Questions? Need help? Feedback? etc.

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