universität innsbruck

Functional Programming	WS 2021	LVA 703025
Exercise Sheet 2, 10 points	Deadline: Wednesday, October 20, 2021, 6am	

- Mark your completed exercises in the OLAT course of the PS.
- Upload your .hs-file of Exercise 3 in OLAT.
- Your .hs-file should be compilable with ghci.

Exercise 1 *Typing* **4 p.**

Given the definition

```
plus1 x = x + 1
```

which of the following typing judgments are valid? Justify your answers.

1. `0 :: Bool` (1 point)
2. `head "test" :: Char` (1 point)
3. `'hello' :: String` (1 point)
4. `plus1 :: Integer -> Integer` (1 point)

Exercise 2 *Parsing expressions* **3 p.**

Draw the abstract syntax trees of the following expressions:

1. `7 * (4 - x) + 5 / 3` (1 point)
2. `(x < 10) || (y > 15)` (1 point)
3. `average 5 10 * square 2 + 10` (1 point)

Remark: function applications (e.g., `square 7`) bind stronger than operator applications (e.g., `3 * 4`).

Exercise 3 *Modelling* **3 p.**

In graphical user interfaces (GUIs) a *menu* typically consists of *items* and submenus. One specific application of such menus is website navigation, where items would consist of a label (the text to click on) and a link (the URL of the website to navigate to when the item is clicked).

1. Give a Haskell datatype definition to model items for website navigation as described above. Moreover, define constants that represent the items OLAT (`https://lms.uibk.ac.at`) and FP (`http://cl-informatik.uibk.ac.at/teaching/ws21/fp`) (1 point)
2. Give a Haskell datatype definition to model menus that may contain up to two items. Moreover, define a constant that represents a menu containing the items for OLAT and FP from above. (1 point)
3. Change your definition from the previous exercise such that a menu contain an arbitrary number of items. Moreover, define a constant that represents a menu with at least three items and also represent this constant as a tree as shown on the slides of week 2, page 23. (1 point)