

CS135B (Fall 2022) Homework 1

Due September 28, 2022

1. For each of the following lambda expressions, apply beta reduction to give a completely reduced expression (i.e., in *beta normal form*):

- (a) $[\lambda y \lambda x. R(y, x)](a)$
- (b) $[\lambda x. [P(x) \rightarrow \exists x. R(b, x)]](a)$
- (c) $(\lambda f \lambda x. f(f(x)))(\lambda y. 1 + y)$

2. What are the types of the following Haskell functions? Explain your answers.

- (a) `second xs = head (tail xs)`
- (b) `swap (x, y) = (y, x)`
- (c) `twice f x = f (f x)`

3. **String processing:** The Haskell function `words` breaks a string up into a list of words, each of which is delimited by whitespace (e.g., spaces, tabs, newlines, etc.). For example:

```
Prelude> words "This is a test, isn't it?"
["This","is","a","test","isn't","it?"]
```

Now you can see that it couldn't separate the comma from "test", or the question mark from "it". Please write a function `pwords` that improves on this by separating punctuation from words. You may assume that the only punctuation marks are in ". , ; ? !". Make sure that you can handle the case when the punctuation mark is in the middle of the word because of a typo:

```
*Main> pwords "John pushed Mary.She fell."
["John","pushed","Mary",".", "She","fell","."]
```

4. **File processing:** Using the function `readFile`, you should be able to write a Haskell file `process_file.hs` that does the following things:
- Waits for the user to input a filename. Reads the content of the file.
 - Prints out the number of words in the file (use `words`).
 - Prints out the number of words ending in “ing” in the file.

You may import and use functions from any modules in the Haskell standard library (e.g., `Data.List`). You should also check Chapter 9 of the Learn You a Haskell book to have an idea of how to write Haskell IO in a syntax similar to declarative languages.

Turning in Your Assignment

Submit two files to LATTE: a PDF document containing your answers to problems 1 and 2, and `process_file.hs`, containing your answers to problems 3 and 4.