CS135B (Fall 2024) Homework 1

Due September 24, 2024

1. Lambda Expressions

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. Haskell Function Types

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:

```
ghci> 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:

```
ghci> 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.
- 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 Moodle: a PDF document containing your answers to problems 1 and 2, and `process_file.hs`, containing your answers to problems 3 and 4.