

CPSC 449: Assignment 4

Fall 2020

See the D2L site for due date/time.

1. [20%] A *polynomial in one variable* (or “polynomial” in short) is defined inductively as follows:

- a constant of type **Int** is a polynomial,
- *the* variable is a polynomial,
- if P and Q are polynomials, then $P + Q$ is a polynomial, and
- if P and Q are polynomials, then $P \times Q$ is a polynomial.

Except for the above there is no other polynomial. Recall that such a polynomial can be represented by the algebraic type below:

```
data Poly = PConst Int |
           PVar |
           PAdd Poly Poly |
           PMul Poly Poly
```

A function f of type **Int**→**Int** is the *denotation*¹ of a **Poly** P iff f is a single-argument function that evaluates P at the argument. For example, $(\backslash x \rightarrow x + x)$ is the denotation of **(PAdd PVar PVar)**. Develop a *denotational compiler* for **Poly**:

```
compilePoly :: Poly -> (Int->Int)
```

such that **(compilePoly P)** returns the denotation of P . The function **compilePoly** must be primitively recursive. An implementation that violates this requirement is considered a *non-solution*!

2. [25%] [Thompson] exercise 11.34. Use the following definition of the function **concat**:

```
concat = foldr (++) []
```

You may also use the axiom **(map++)** on page 261 (under Exercise 11.31).

¹For the mathematically minded, we assume that function equality is defined in an extensional manner, as described in §11.6 of [Thompson].

3. [30%] Complete the implementation of the **Expr** parser as presented in the lecture slides. Your code should be based on **parser.hs**, which has been posted at the course web site. **Important:** *You are not allowed to modify the code that is already given in **parser.hs**.* Specifically, you need to provide the implementation for the following functions:
- **isOp** and **charToOp** (see [Thompson] exercise 17.12)
 - **makeExpr**
 - **optional** and **neList** (see [Thompson] exercise 17.10)
 - **stringToExpr** (see [Thompson] exercise 17.14)
4. [25%] [Thompson] exercise 17.25.