

98-317 Homework 2: Algebraic Datatypes and Type Derivatives

Email solutions to cjwong@andrew.cmu.edu by the end of 2020-01-28.

Solve the following problems to the best of your ability. Incorrect or incomplete answers will be accepted if a reasonable attempt is present. *Please* do not spend more than 60 minutes on this homework if you don't want to. Post on Piazza if you need help or would like to discuss further.

1. Give the algebraic representation for each of the following:

(a) `datatype r = A | B of r | C of (r * r * r)`

(b) `datatype t = Z | S of t`

(c) `datatype 'a u = NN | SS of 'a`

2. Give a one-hole context for the following type (in SML):

```
datatype 'a t = Empty
             | Binode of 'a * ('a t * 'a t)
             | Trinode of 'a * ('a t * 'a t * 'a t)
```

3. So far, all the polynomial types we've explored or discussed so far have been some form of colored tree-like structure. Do these techniques generalize to arbitrary graphs? Explain.
4. (OPTIONAL) What common data structure is represented by the recursive function F ?

$$F(\alpha) = 1 + \alpha \times G(\alpha)$$

$$G(\alpha) = 1 + F(\alpha) \times G(\alpha)$$

5. (OPTIONAL) Take the one-hole context of F from the previous question and describe how this data structure works.