

CS558 Programming Languages – Fall 2023 – Study Questions Lecture 8a

1. Work through the `TypesInHaskell.hs` file, doing the exercises as you go.
2. Consider the following six informal data type descriptions:
 - Type A describes 2–3 trees containing integer values. A 2–3 tree is a kind of search tree (suitable for representing sets or dictionaries), in which every internal node has either one data element and two children, or two data elements and three children; leaf nodes have no data.
 - Type B represents boolean bit vectors, where a bit vector is (i) empty, or (ii) a single boolean, or (iii) the concatenation of two bit vectors.
 - Type C is an enumeration type for the four seasons of the year.
 - Type D represents values of parts records in a manufacturing database, containing fields for part id (integer), part name (string), unit cost (float), and quantity on hand (integer).
 - Type E represents points on the complex plane. Each point can be represented in either rectangular or polar coordinates, using type `float` to represent the coordinates.
 - Type F represents a pair of functions: the first function is from some type t to some type u , and the second function is the inverse of the first.

Here is a possible mathematical type equation defining type A:

$$A = (\text{Int} \times A \times A) + (\text{Int} \times \text{Int} \times A \times A \times A) + \mathbf{1}$$

(Note that this particular equation is recursive. Also note that we write $\mathbf{1}$ for the mathematical type corresponding to a set with exactly one element.)

Write down a mathematical type equation corresponding to each of the types B,C,D,E, and F.