Compound-type flavors (from Lec 4)

Conceptually, just a few ways to build compound types:

1. “Each-of”: A t contains a t1 and a t2; e.g., int * bool
2. “One-of”: A t contains a t1 or a t2; w.g., int option
3. “Self-reference”: The definition of t refers to t; e.g., int list

More generally, e.g.:

```
datatype myTree = SLeaf of string
| ILeaf of int
| Node of myTree * myTree
```

A lot of data can be described this way.

(optional) jargon: Product types, sum types, recursive types
Data in Scheme

Recall ML’s approach to each-of, one-of, and self-referential types.

Pure Scheme’s approach:

• There is One Big Datatype with built-in predicates.

• Use pairs (lists) for each-of types.

• Primitives implicitly raise errors for “wrong variant”

• Use helper functions like caddrx and your own.
define-struct

MzScheme extends Scheme with define-struct, e.g.:

(define-struct square (x y))
(define-struct piece (squares))

Semantics:

- Binds constructors (make-square, make-piece) that take arguments and make values.
- Binds predicates (square?, piece?) that take one argument and return #t only for values built from the right constructor.
- Binds accessors (square-x, square-y, piece-squares) that take one argument, return the appropriate field, and call error for values not built from the right constructor.
- Binds mutators (set-square-x!, set-square-y!, set-piece-squares!).
define-struct is special

define-struct creates a new variant for the One Big Datatype.

Claim: define-struct is not a function.

Claim: define-struct is not a macro.

It could be a macro except for one key bit of its semantics: Values built from the constructor cause every other predicate (including all built-in ones) to return #f.

Advantage: abstraction

Disadvantage: Can't write “generic” code that has a case for every possible variant in every Scheme program.
Idiom for ML datatypes

Instead of a datatype with $n$ constructors, you just use define-struct $n$ times.

That “these $n$ go together” is just convention.

Instead of case, you have a cond with $n$ predicates and one “catch-all” error case.