(RATs !

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Motivation

- Using algebraic ty
- But what if we want m
- How could we ever define our own types that were as powerful as num or [c
- Easy ! — use recursion

Type Domains Revisited

- The type [char] has m
- However, the defin
  - A list of char may
  - Or a char together with a list of char
- This is the basis of the definition of algebraic types that potentially con

Example RATs/PRATs

- A simple recursive algebraic type :
  mylistchar ::= MyNil | MyCons char mylistchar

- A **polymorphic** recursive algebraic type :
  mylist * ::= Empty | Co

- A function that oper

$$myhd :: (mylist\ *) -> \ *$$

$$myhd\ Empty \quad = err$$

$$myhd\ (Cons\ x\ xs) \quad = x$$

$$main \ = \ myhd\ (Cons\ 'A'\ (Cons\ 'B'\ (Cons\ 'C'\ Empty)))$$

Example RATs/PRATs (2)

- Example tree type :

```
bintree * ::= Emptytree | Nod * (bi

rightmost :: bintree *
rightmost Empty
rightmost (Node x lt Emptytree) = x
rightmost (Node x lt rt) = rightmost rt

x = (Node 3 (Node 4 Emptytree Emptytree) Emptytree)
main = rightmost x
```

Functions on sorted trees

- Adding an element to a **sorted** tree of numbers :

ins

ins

$inserttree \quad (Node\ v\ lt\ rt)\ x \quad = \quad Node\ v \quad \ldots \quad <= v)$

$= \quad Node\ v\ lt \quad \ldots \quad wise$

Functions on sorted trees (2)

- Membership of a **sorted** tree of numbers :

$$membertree\ (Node\ v\ lt\ rt)\ x \quad =$$
$$= (\qquad = v)$$
$$= (\qquad se$$

Function on an unsorted tree

- Compare with membership of an **unsorted** tree of numbers :

$$
\begin{aligned}
&\mathit{memberutree} \\
&\mathit{memberutree} \\
&\mathit{memberutree}\ (\mathit{Node}\ v\ \mathit{lt}\ \mathit{rt})\ x &= \mathit{True},\ \mathit{if}\ (\\
& &= (\mathit{memberu} \ldots t\ x),\ \mathit{otherwise}
\end{aligned}
$$

Functions on sorted trees (3)

- Removing an element from a sorted tree of numbers :

su

su

su ... *ytree*)

$x < v$)

$=$ *Node v lt*)

$=$ *Node ne* ... *erwise*

where

new $=$ *rightmost lt*

Summary

- Motivation : why do
  - Type domain
- Example RATs and Polymorphic RATs :
  - Lists
  - Trees

- Functions that operate on sorted trees

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