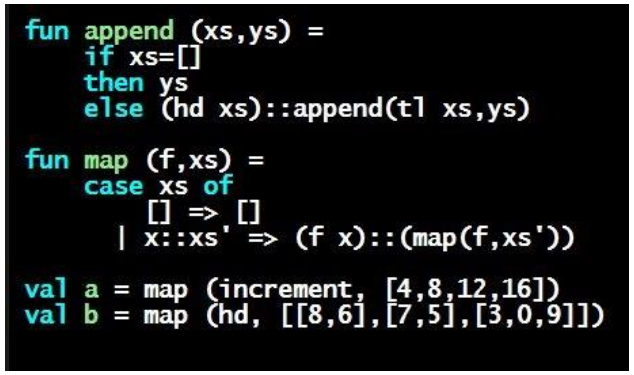

Programming Languages

Dan Grossman

Pattern-Matching for Each-Of Types: The Truth About Function Arguments

An exciting segment

Learn some deep truths about “what is really going on”

- Using much more syntactic sugar than we realized

- Every val-binding and function-binding uses pattern-matching

- Every function in ML takes exactly one argument

First need to extend our definition of pattern-matching…

Each-of types

So far have used pattern-matching for one of types because we *needed* a way to access the values

Pattern matching also works for records and tuples:

- The pattern **`(x1,…,xn)`**
  matches the tuple value **`(v1,…,vn)`**
- The pattern **`{f1=x1, …, fn=xn}`**
  matches the record value **`{f1=v1, …, fn=vn}`**
  (and fields can be reordered)

Example

This is poor style, but based on what I told you so far, the only way to use patterns

- Works but poor style to have one-branch cases

```
fun sum_triple triple =
    case triple of
      (x, y, z) => x + y + z

fun full_name r =
    case r of
      {first=x, middle=y, last=z} =>
          x ^ " " ^ y ^ " " ^ z
```

Val-binding patterns

- New feature: A val-binding can use a pattern, not just a variable
  - (Turns out variables are just one kind of pattern, so we just told you a half-truth in lecture 1)

```
val p = e
```

- Great for getting (all) pieces out of an each-of type
  - Can also get only parts out (not shown here)

- Usually poor style to put a constructor pattern in a val-binding
  - Tests for the one variant and raises an exception if a different one is there (like **`hd`**, **`tl`**, and **`valOf`**)

Better example

This is okay style

- Though we will improve it again next
- Semantically identical to one-branch case expressions

```
fun sum_triple triple =
    let val (x, y, z) = triple
    in
        x + y + z
    end

fun full_name r =
    let val {first=x, middle=y, last=z} = r
    in
        x ^ " " ^ y ^ " " ^ z
    end
```

Function-argument patterns

A function argument can also be a pattern

- Match against the argument in a function call

```
fun f p = e
```

Examples (great style!):

```
fun sum_triple (x, y, z) =
    x + y + z

fun full_name {first=x, middle=y, last=z} =
    x ^ " " ^ y ^ " " ^ z
```

A new way to go

- For Homework 2:
  - Do not use the **#** character
  - Do not need to write down any explicit types

Hmm

A function that takes one triple of type **`int*int*int`** and returns an **`int`** that is their sum:

```
fun sum_triple (x, y, z) =
    x + y + z
```

A function that takes three **`int`** arguments and returns an **`int`** that is their sum

```
fun sum_triple (x, y, z) =
    x + y + z
```

See the difference? (Me neither.) ☺

The truth about functions

- In ML, every function takes exactly one argument (*)

- What we call multi-argument functions are just functions taking one tuple argument, implemented with a tuple pattern in the function binding
  - Elegant and flexible language design

- Enables cute and useful things you cannot do in Java, e.g.,

```
fun rotate_left (x, y, z) = (y, z, x)
fun rotate_right t = rotate_left(rotate_left t)
```

* "Zero arguments" is the unit pattern `()` matching the unit value `()`