Introduction to Functional Programming in *OCaml*

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Week 3 - Sequence 5: Advanced topics about data types









Precise typing

► A sum type with only one constructor can be useful to discriminate between two types that are structurally equivalent but semantically different

Euros are not dollars I

```
type euro = Euro of float;;
# type euro = Euro of float
type dollar = Dollar of float;;
# type dollar = Dollar of float
let euro of dollar (Dollar d) = Euro (d /. 1.33);;
# val euro of dollar : dollar -> euro = <fun>
let x = Dollar 4.::
# val x : dollar = Dollar 4.
let y = Euro 5.;;
# val y : euro = Euro 5.
```

Euros are not dollars II

Disjunctive patterns

- ► Sometimes, the same code is duplicated in several branches.
- ▶ or-patterns allow you to factorize these branches into a unique branch.
- ► "some_pattern_1 | some_pattern_2" corresponds to the observation of some_pattern_1 or some_pattern_2.
- ▶ some_pattern_1 and some_pattern_2 must contain the same identifiers.

Disjunctive pattern I

```
let remove zero or one head = function
  | 0 :: xs -> xs
  | 1 :: xs -> xs
  1 1 -> 1::
# val remove zero or one head : int list -> int list = <fun>
let remove zero or one head' = function
  \mid 0 :: xs \mid 1 :: xs \rightarrow xs
  1 1 -> 1::
# val remove zero or one head' : int list -> int list = <fun>
let remove zero or one head'' = function
  | (0 | 1) :: xs -> xs
  1 1 -> 1::
# val remove zero or one head'': int list -> int list =
  <fun>
```

as-patterns

- ▶ It is sometimes convenient to name a matched component.
- ► The pattern "some_pattern as x" is read as "If the value can be observed using some_pattern, name it x."

as-pattern I

```
let rec duplicate_head_at_the_end = function
    | [] -> []
    | (x :: _) as l -> l @ [x];;

# val duplicate_head_at_the_end : 'a list -> 'a list = <fun>
let l = duplicate_head_at_the_end [1;2;3];;

# val l : int list = [1; 2; 3; 1]
```

Constrained pattern matching branch using when

- ▶ A boolean expression, called a **guard**, can add an extra constraint to a pattern.
- ► This guard is introduced by the keyword when.

Guarded patterns I

```
let rec push_max_at_the_end = function
    | ([] | [_]) as 1 -> 1
    | x :: ((y :: _) as 1) when x <= y -> x :: push_max_at_the_end 1
    | x :: y :: ys -> y :: push_max_at_the_end (x :: ys);;
# val push_max_at_the_end : 'a list -> 'a list = <fun>
```

Other kinds of types

- ▶ There are advanced features of the type system that we did not show:
 - ▶ Objects
 - ► First-class modules
 - Polymorphic variants
 - ► Generalized algebraic datatypes

Next week, you will learn how to write higher-order programs over all the types we have seen so far!