

非手続き型言語4回目課題 解答例

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1 演習問題 3.3.13

```
fun inserteach(_,nil) = nil  (* これは演習問題 3.3.12 の解答 *)
  | inserteach(a,x::xs) = (a::x)::inserteach(a,xs);

fun powerset(nil) = [nil]
  | powerset(x::xs) = powerset(xs)@inserteach(x,powerset(xs));
```

2 演習問題 3.4.3

```
(* Ex. 3.3.13 の局所環境版 *)
fun PowerSet(nil) = [nil]
  | PowerSet(x::xs) =
    let
      val s = PowerSet(xs)
    in
      s@inserteach(x,s)
    end;
```

3 演習問題 3.4.4

```
(* 演習問題 3.2.1 f のときはこうしたはず *)
fun maxnumber2(x::nil) = x:real
  | maxnumber2(x::xs) = if x > maxnumber2(xs) then x
                        else maxnumber2(xs);

fun maxnumber2(x::nil) = x:real
  | maxnumber2(x::xs) =
    let
      val m = maxnumber2(xs)
    in
      if x > m then x
```

```

        else m
      end;

(* こういう解答でもいい *)
fun maxnumber3(x::nil) = x:real
|   maxnumber3(x::xs) =
  let
    fun max(a,b) = if a > b then a else b
  in
    max(x, maxnumber3(xs))
  end;

(* 上の解答例では Warning : match nonexhaustive が出る.
   例外を用いてそれが出ないようにした改良版*)

```

```

exception NullList;
fun maxnumber4(nil) = raise NullList
|   maxnumber4(x::nil) = x:real
|   maxnumber4(x::xs) =
  let
    val m = maxnumber4(xs)
  in
    if x > m then x
    else m
  end;

```

4 演習問題 5.2.1

```

exception TooShort;
fun thirdelement(nil) = raise TooShort
|   thirdelement(x::nil) = raise TooShort
|   thirdelement(x::y::nil) = raise TooShort
|   thirdelement(x::y::z::zs) = z;

```

```

(*スマートな解答*)
exception TooShort;
fun   thirdelement(x::y::z::zs) = z
|     thirdelement(_) = raise TooShort;

```

5 演習問題 5.2.2

```

exception Negative;
fun fact(0) = 1
|   fact(n) =

```

```

    if n > 0 then n * fact(n-1)
    else raise Negative;

```

6 実行結果

```

- use "ML4answer.ml";
[opening ML4answer.ml]
val inserteach = fn : 'a * 'a list list -> 'a list list
val powerset = fn : 'a list -> 'a list list
val PowerSet = fn : 'a list -> 'a list list
ML4answer.ml:26.5-33.9 Warning: match nonexhaustive
    x :: nil => ...
    x :: xs => ...

val maxnumber2 = fn : real list -> real
ML4answer.ml:36.5-42.7 Warning: match nonexhaustive
    x :: nil => ...
    x :: xs => ...

val maxnumber3 = fn : real list -> real
exception NullList
val maxnumber4 = fn : real list -> real
exception TooShort
val thirdelement = fn : 'a list -> 'a
exception TooShort
val thirdelement = fn : 'a list -> 'a
exception Negative
val fact = fn : int -> int
val it = () : unit
- powerset ([1,2,3]);
val it = [[], [3], [2], [2,3], [1], [1,3], [1,2], [1,2,3]] : int list list
- PowerSet ([1,2,3]);
val it = [[], [3], [2], [2,3], [1], [1,3], [1,2], [1,2,3]] : int list list
- maxnumber2 ([3.0, 1.2, ~1.1, 4.0]);
val it = 4.0 : real
- maxnumber4 ([]);

uncaught exception NullList
  raised at: ML4answer.ml:48.29-48.37
- thirdelement ([1,2,3,4,5]);
val it = 3 : int
- thirdelement ([1,2]);

uncaught exception TooShort
  raised at: ML4answer.ml:79.31-79.39

```

```
- fact (5);  
val it = 120 : int  
- fact (~3);  
  
uncaught exception Negative  
  raised at: ML4answer.ml:88.17-88.25  
-
```