Homework 1
COSE212, Fall 2015

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Due: 09/25, 24:00

Problem 1 Consider the following triangle (it is called Pascal's triangle):

$$\begin{array}{ccccccc} & & & 1 & & & \\ & & 1 & & 1 & & \\ & 1 & & 2 & & 1 & \\ 1 & & 3 & & 3 & & 1 \\ 1 & & 4 & & 6 & & 4 \quad 1 \\ & & & \cdots & & & \end{array}$$

where the numbers at the edge of the triangle are all 1, and each number inside the triangle is the sum of the two numbers above it. Write a function

```
pascal: int * int -> int
```

that computes elements of Pascal's triangle. For example, `pascal` should behave as follows:

```
pascal (0,0) = 1
pascal (1,0) = 1
pascal (1,1) = 1
pascal (2,1) = 2
pascal (4,2) = 6
```

Problem 2 Write a function

```
sigma : (int -> int) -> int -> int -> int
```

such that `sigma f a b` computes

$$\sum_{i=a}^{b} f(i).$$

For instance,

```
sigma (fun x -> x) 1 10
```

evaulates to 55 and

```
sigma (fun x -> x*x) 1 7
```

evaluates to 140.

Problem 3 Write two functions

```
max: int list -> int
min: int list -> int
```

that find maximum and minimum elements of a given list, respectively. For example `max [1;3;5;2]` should evaluate to 5 and `min [1;3;2]` should be 1.

Problem 4 We can define the propositional formula as follows:

```
type formula =
    True
  | False
  | Neg of formula
  | Or of formula * formula
  | And of formula * formula
  | Imply of formula * formula
  | Equiv of formula * formula
```

Write a function

```
eval : formula -> bool
```

that evaluates a given propositional formula.

Problem 5 Natural numbers can be defined as follows:

```
type nat = ZERO | SUCC of nat
```

For instance, `SUCC ZERO` denotes 1 and `SUCC (SUCC ZERO)` denotes 2. Write two functions that add and multiply natural numbers:

```
natadd : nat -> nat -> nat
natmul : nat -> nat -> nat
```

For example,

```
# let two = SUCC (SUCC ZERO);;
val two : nat = SUCC (SUCC ZERO)
# let three = SUCC (SUCC (SUCC ZERO));;
val three : nat = SUCC (SUCC (SUCC ZERO))
# natmul two three;;
- : nat = SUCC (SUCC (SUCC (SUCC (SUCC (SUCC ZERO)))))
# natadd two three;;
- : nat = SUCC (SUCC (SUCC (SUCC (SUCC ZERO))))
```

How to submit

1. Download the homework 1 template file (`hw1.ml`) from the course webpage: `http://prl.korea.ac.kr/~hakjoo/home/courses/cose212/2015`
2. Replace all `(* TODO *)` in `hw1.ml` by your own code.
3. Submit the single file `hw1.ml` via Blackboard.