# Problem Set 7
# COMP301 Fall 2022
### Week 8: 28.11.2021 - 02.12.2021

**Instructions:**

- Submit your answers to the Blackboard PS7 assignment until December 3th Saturday, at 23.59.
- Please use the code boilerplate, which includes several tests for you to see if your code is correct.
- Submit your code and PDF file to BlackBoard as a single zip file *yourIDno_ username.zip*. (Example: *123456_ otal19_ ps7.zip*)

**Problem 1:**

**a).** Draw the contour diagram of the following program. Specify declarations and references.

```
let x = 23 in
    proc (x, y)
        let z = proc (y, x) -(y, 1) in
            let t = -(z, x)
                in (z t)
```

**b).** Consider the expression

```
let z=4 in
    letrec f(x) = if zero?(x) then 1
                                else (f -(x, 1))
                  in (f z)
```

Draw the environment that is passed to `value-of` when the expression `1` is evaluated. Show the intermediate steps in each value-of call and apply-env call. You can skip the value-of calls which `if-exp` is evaluated. (See Lecture15)

**Problem 2:**

**a).** [1]: Extend the `letrec` language to allow the declaration of any number of mututally recursive unary procedures, for example:

```
letrec-m
  even(x) = if zero?(x) then 1 else (odd -(x,1))
  odd(x) = if zero?(x) then 0 else (even -(x,1))
in (odd 13)
```

evaluates to 1 because 13 is an odd number. The `letrec` implementation is given. Make the necessary modifications stated below.

[1] EOPL p.84-85 Exercise 3.32

**Note 1**: Methods that need to be modified are highlighted inside the `LETREC` language source code with some hints. See the following files: `data-structures.rkt`, `environment.rkt`, `interp.rkt` and `lang.rkt`

**Note 2**: You need to update the following files: `environment.rkt`, `data-structures`, `interp.rkt` and `lang.rkt`.

**Note 3**: Do not forget to uncomment necessary tests in `test.rkt`.

**b).** Could `letrec` and `letrec-m` be merged? What would be the necessary changes? Discuss the necessary changes in your report, they can be applied on given zip file as a challenge but not required.