Problem Set 5
Comp 301
Spring 2023
Week 5: 31.03.2023 - 01.04.2023

Instructions:

- Submit your answers to the Blackboard PS5 assignment until April 1st Saturday, at 23.59.
- Please use the code boilerplate for `LET` language, which includes several tests for you to see if your code is correct.
- Save your code, write your answers for the first two questions on a piece of paper or online environment and include it as a PDF. Zip your code along with the PDF as `ID_username.zip` with your ID and username (Example: `1234567_fsofian19.zip`), and submit this ZIP file.
- Read the questions carefully. Good luck!

Problem 1: [1]: Write out the derivation of the following program as a derivation tree. Check figures 1 and 2 as examples.

Let $\rho = [x = \lceil 20 \rceil, y = \lceil 15 \rceil, z = \lceil 10 \rceil]$

```
if zero?(-(z, y)) then -(x, z) else -(12, x)
```

Example 1: `if zero?(0) then 5 else 2`

$$\frac{\texttt{(value-of «zero?(0)» } \rho \texttt{ = (bool-val t))}}{\texttt{(value-of «if zero?(0) then 5 else 2 » } \rho\texttt{) = 5}}$$

FIGURE 1. Derivation tree for "if zero?(-(y, 10)) then 5 else 2"

Example 2: `zero?(-(x, y))`

$$\frac{\dfrac{\texttt{(value-of «x» } \rho\texttt{) = 20 (value-of «y» } \rho\texttt{) = 15}}{\texttt{(value-of «-(x, y)» } \rho\texttt{) = 5}}}{\texttt{(value-of «zero?(-(x, y))» } \rho\texttt{) = (bool-val \#f)}}$$

FIGURE 2. Derivation tree for "zero?(-(x, y))"

Problem 2: Now, we want you to fill in the blanks for the output of this interpreter. Similar to first question let $\rho_0 = [x = \lceil 20 \rceil, y = \lceil 15 \rceil, z = \lceil 10 \rceil]$. Note that below snippet is not complete, although we only want answers to the `_____`'s, we recommend you to continue the evaluation as a self study exercise.

[1] Similar to EOPL p.70 Exercise 3.4

```
let n = 15 in if zero?(-(x, n)) then -(x, y) else -(-(z, n), -(y, x))
(value-of
   <<let n = 15
      in if zero?(-(x, n)) then
      -(x, y)
      else -(-(z, n), -(y, x))>>
  ρ0)

= (value-of
   <<if zero?(-(x, n)) then
      -(x, y)
      else -(-(z, n), -(y, x)))>>
   ____[1]____)

Let ρ1 = ____[2]____

= (if (expval->bool (value-of <<zero?(-(x, n))>> ρ1))
      (value-of <<-(x, y)>> ρ1)
      (value-of <<-(-(z, n), -(y, x)))>> ρ1))

= (if ____[3]____
   (value-of <<-(x, y)>> ρ1)
   (value-of <<-(-(z, n), -(y, x)))>> ρ1))

= (value-of <<____[4]____>> ρ1)

= ⌈(-
   ⌊(value-of <<____[5]____>> ρ1) ⌋
   ⌊(value-of <<____[6]____>> ρ1) ⌋)⌉

= ____[7]____
```

Problem 3: Parse the following code into an abstract syntax tree:
`((lambda (f) (f x)) y)`