

Homework: VarLang

Instructions:

- Early deadline: Sept 20 (Wed) 2017 at 11:00 PM; Regular deadline: Sept 22 (Fri) 2017 at 11:00 PM
- Use Varlang interpreter for all the questions.
- For questions 1–4, Write your answers in hw3.txt and save it at pldiscode/src/varlang/example/hw3.txt
- For questions 5–6, extend the Varlang interpreter, export your homework solution as archive file (File->Export->General->archive), and attach the archive file. Please provide the complete project as submission not just the src directory.

Questions:

- (3 pt) Write a Varlang program for each of the following statements.
 - Let y be 4. Let z be 10. Then, the result is y+z.
 - Let x be 2. Then, the result is $4\pi r^2$. //Area of circle.
 - Let x be 10, y be 12 and z be (x+y). Then, the result is x+y-z.
- (15 pt) Write five different 'let' expressions using the syntax of Varlang such that each expression evaluates to value 21. Each expression must include at least 2 nested let expressions and there must be a "hole in one of the scopes." (The definition of this is seen in section 3.3 of Rajan-PL book pg 48)


```
(let ((x 2) (y 8)) (let ((x 3) (z 10)) (let ((z 3)) (- (* x y) z))))
```

\$ 21
- (6 pt) Draw the parse trees for the following let programs:
 - (let ((x (let ((y 4)) (+ y 5)))) x)
 - (let ((x 2)(y (+ 4 3))) (* x (- 1 3)))
 - (+ (let((x 23)) x) (let ((y 1)) (+ y 4)))
- (10 pt) We present several Varlang programs below. For each program write down the free and bound variables. If a program does not have free variable, say None.
 - (let ((a 1)) (/ a 2))
 - (let ((c 3) (c p)) (let ((s 2)) (+ c 1 s)))
 - (let ((g 6)(y 5)) (let ((x y)) x))
 - (+ s (let ((x (+ 2 (let ((x 23) y))))x))
 - (let ((q 5)) (let ((r q)) r))

5. (25 pt) Let expression is useful to define multiple variables at the same time. However, one might want to refer to the previous defined variables in the same let expression when defining later variables. For example, in the evaluation of `(let ((a 3) (b a) (c (+ a b))) c)`, we created three variables, `a`, `b` and `c`, where `a=3`, `b=a`, `c=a+b`. This problem asks you to modify existing let evaluator to support this behavior.
6. (30 pt) Security is major concern for any system. To deal with this it becomes important that deallocated memory of some program does not contain the data which can be read by malicious programs thereby causing leak of information. To avoid such information leak due to environment storage we can augment the Varlang language with a `lete` (encoded let) expression that encodes the value before storing in environment and `dec` expression that decodes it prior to using it.

Extend the Varlang programming language to support these two expressions. Implement an encrypted let (`lete` for let encrypted), which is similar to `let` but takes an additional parameter `key` and a `dec` expression that is similar to `VarExp`. All values are stored by encrypting them with `key`, and read by decrypting them with `key`.

```
> (lete 42 ((x 1)) x)
43
> (lete 42 ((x 1)) (dec 42 x))
1
> (lete 10 ((y 12)) y)
22
> (lete 10 ((y 12)) (dec 10 y))
12
```