COP 5555 Programming Language Principles, Spring 2013
Homework 2
Assigned: February 18, 2013
Deadline: February 25, 2013

*Note: Please submit your solution to the e-learning system by the deadline. No late submission is allowed.

1. Problem 1 (18 Points)
The following RPAL program is overly parenthesized; remove all superfluous parentheses, i.e. minimize the parentheses without changing the meaning of the program.

Also, format the program by writing it on several lines with the appropriate indentation.

```
let (x = ((a * b)-c)) in ((e & f) -> (g -> x ** (x**2) | y) | (f(x) where ((f(y) = (y*2)) and (x=(2 + (x ** 2))))))
```

2. Problem 2 (25 Points)
Write, test, and debug an RPAL program that computes the "tuple reverse" function:

Rev(4,'hello',(3,4),true) = (true,(3,4),'hello',4).

Please write them on several lines with the appropriate indentation.

3. Problem 3 (25 Points)
Explain the behavior of the following RPAL program, and the type of each identifier which appeared:

Let Prod N = P 1 N where rec P Cum N = N eq 1 -> Cum | P (Cum*N)
in Print (Prod 5 4 3 2 1)

Make an honest attempt at figuring it out BEFORE asking the RPAL interpreter.

4. Problem 4 (32 Points)
Using the RPAL string-to-tree-transduction grammar, draw the abstract syntax tree (if possible) for each of the following programs:
(a) x or y -> x | z -> x | y
(b) $x eq y -> z -> x| y| x$
(c) $x aug y, z, 3$
(d) $x, y, z aug 3$
(e) $(\text{let } f(x) = x*2+1 \text{ in } f(z) \text{ where } z=6)$
(f) item (e) above with all the parentheses removed
(g) let $x = z$ and $y = 2 * z$ where $z = 3$ in $x** y**y$
(h) let $x = y$ in $x * z ** y$ where $z = 4$ and $p = 3*y$