

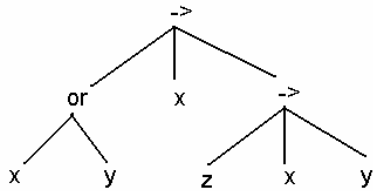
COP4020 Spring 2008 Homework-3 Solutions

1. Using the RPAL string-to-tree-transduction grammar, construct the abstract syntax tree (if possible) for each of the following programs:

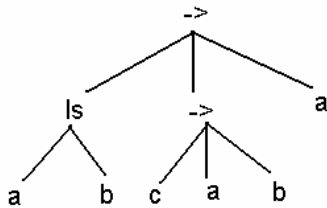
- (a) $x \text{ or } y \rightarrow x \mid z \rightarrow x \mid y$
- (b) $a < b \rightarrow c \rightarrow a \mid b \mid a$
- (c) $x \text{ aug } y, z, 3$
- (d) $x, y, z \text{ aug } 3$
- (e) let $f(x) = x + 2 * 1$ in $f(z)$ where $z = 6$
- (f) let $x = z$ and $y = 2 * z$ where $z = 3$ in $x ** y ** y$
- (g) let $a = c$ in $a * b ** c$ where ($z = 3$ and $y = 2 * z$)
- (h) let $a = c$ in $a * b ** c$ where $z = 3$ and $y = 2 * z$

Answer:

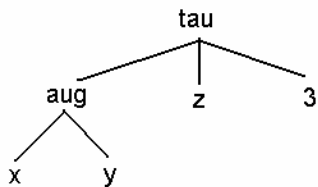
(a)



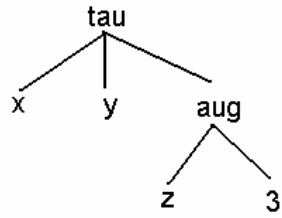
(b)



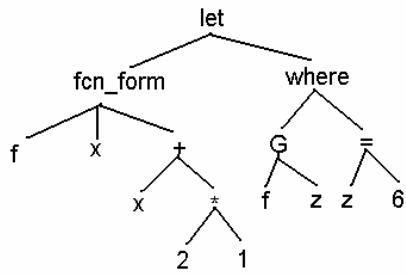
(c)



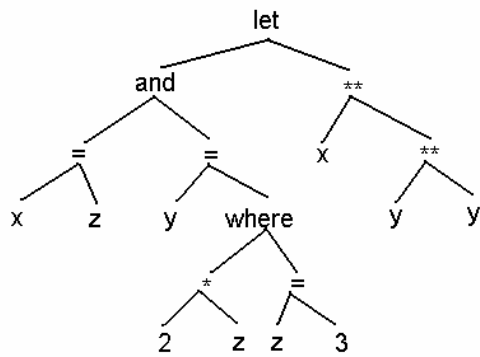
(d)



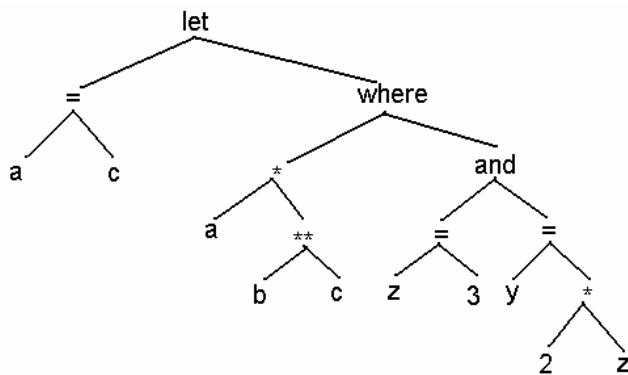
(e)



(f)



(g)



(h) No AST is possible.

2. Write RPAL Programs:

Write, test, and debug an RPAL program that computes the “tuple reverse” function, i.e. $\text{Rev}(3, \text{'hello'}, (2, 3), (\text{fn } x.x+1), \text{true}) = (\text{true}, (\text{fn } x.x+1), (2, 3), \text{'hello'}, 3)$.

Answer:

```
let Rev T = Prev (T, 1)
  where rec Prev (T, N) = N gr (Order T) -> nil
    | (Prev (T, N+1) aug (T N))
  in
  Print (Rev (1, '2', (3, 2), true, (fn x.3), nil))
```

3. Scoping Rules: (Scott Exercise 3.4 P 152)

Give three concrete examples drawn from programming languages with which you are familiar in which a variable is live but not in scope.

Answer:

- (1) C: Global variable x is still live but not in the scope if a local variable x is declared in the scope.
- (2) Modula-2: a global variable declared in a module is live but not in scope when execution is not inside the module.
- (3) C++: non-public member variables of an object of class C are live but not in scope when execution is not inside a member function of C .