

COP5621 Fall 2011 – Extra Credit Homework 3

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Due date: November 3, 2011

1. Textbook 2nd ed. exercise 5.1.1 p.309 (or Textbook 1st ed. exercise 5.1 p.336).
2. Rewrite the following SDT:

$$\begin{array}{l} A \rightarrow A \{a\} B \mid A B \{b\} \mid 0 \\ B \rightarrow B \{c\} A \mid B A \{d\} \mid 1 \end{array}$$

so that the underlying grammar becomes non-left-recursive. Here, a , b , c , and d are actions, and 0 and 1 are terminals.

3. The following grammar defines a string of 0's and 1's:

$$\begin{array}{l} B \rightarrow B 0 \\ \quad \mid B 1 \\ \quad \mid 0 \\ \quad \mid 1 \end{array}$$

Rewrite the grammar into a syntax-directed translation (SDT) scheme that computes the positive value of the string. For example, 0101 is translated into 5.

4. Consider the following post system rules for type checking logical expressions over variables:

$$\frac{\rho(v) = \tau}{\rho \vdash v : \tau} \quad \frac{\rho \vdash e : \text{bool}}{\rho \vdash !e : \text{bool}} \quad \frac{\rho \vdash e_1 : \text{bool} \quad \rho \vdash e_2 : \text{bool}}{\rho \vdash e_1 \&\& e_2 : \text{bool}} \quad \frac{\rho \vdash e_1 : \text{bool} \quad \rho \vdash e_2 : \text{bool}}{\rho \vdash e_1 \parallel e_2 : \text{bool}}$$

where we assume the usual associativity and precedence rules for $\&\&$ and \parallel apply. Suppose $\rho = \{\langle \mathbf{a}, \text{bool} \rangle, \langle \mathbf{b}, \text{bool} \rangle, \langle \mathbf{c}, \text{bool} \rangle\}$ prove that $\rho \vdash \mathbf{a} \&\& \mathbf{b} \parallel !\mathbf{c} : \text{bool}$

5. Consider the type declaration

```
struct BinTree
{
    int val;
    struct BinTree *left;
    struct BinTree *right;
};
```

Draw a graph that shows how the C compiler represents this type internally.

6. Consider the following C code:

```
struct BinTree *p;  
int q;  
...  
p->left->val = q;
```

Draw a graph (based on the previous question) for the types of `p`, `p->left`, `p->left->val`, and `q` that shows that the assignment `p->left->val = q` is typed correctly.