CS 310, Assignment 5

Due on 27 March in class

1. Consider the following context-free grammar with start symbol S, nonterminals $\{S, A, B, C\}$, and terminals $\{0, 1\}$:

$$S \to A0 \qquad A \to B \qquad A \to C1 \qquad B \to 1 \qquad B \to \varepsilon \qquad C \to 0$$

   (a) Compute *all* the sets FIRST and FOLLOW necessary to implement a recursive decent parser for this grammar. However, do not list any unnecessary such a set.

   (b) Investigate all the combinations of sets FIRST and FOLLOW that are involved in the implementation of a recursive descent parser for this grammar. Explain how these combination make the grammar suitable or unsuitable (as the case might be) for recursive descent parsing.

2. What should the pre-condition P be in each of the following correctness statements for the statement to be an instance of Hoare's assignment axiom scheme?

   (a) P `{ x = 1; } x <= 2`

   (b) P `{ y = x - y; } y*y > 5`

   (c) P `{ i = i - k; } ForAll (i=0; i<10) i+k > 0`

   (d) P `{ i = i - k; } Exists (k=0; k<i) k+m > i`

3. Add all the intermediate assertions and so produce the proof tableau for the following statements. If a statement is not valid then include in your respective tableau a pre-condition that is just strong enough to make the statement valid.

   (a)
```
ASSERT(true)
m = 1;
n = 1;
n = a-b;
ASSERT(m*n > 0)
```

   (b)
```
ASSERT(x == y*(y+1))
y = y + 1;
x = x + 2*y;
ASSERT(x == y*(y+1))
```

   (c)
```
ASSERT(false)
y = 1;
ASSERT(x+y<=0)
```

(d)
```
ASSERT(true)
if (x >= y) x = x + 1; else y = x - 1;
z = y - 1;
ASSERT(z < y < x)
```

Make sure you review the submission guidelines posted on the course's Web site before handing in your answers.