CS 304: Programming Languages
Assignment 3

September 24th, 2012

Due: Monday, October 1st, 2012 before the beginning of the class period

1. (1 pts) Consider the following grammar for a string of binary bits:

S → L . L | L
L → L B | B
B → 0 | 1

The symbols **S**, **L**, and **B** are non-terminals and **0** and **1** are terminals.
Construct the attribute grammar to compute a decimal equivalent of a binary number. Please make sure that the fractions are computed correctly. Show that your attribute grammar indeed computes the correct value on the string "**1101.011**".

2. (1 pts) Write a grammar for the language consisting of strings that have *n* copies of the letter *a*, followed by the same number of copies of the letter *b*, where *n>0*. For example, the strings *ab*, *aaaabbbb*, and *aaaaaaaabbbbbbbb* are in the language, but *a*, *abb*, *ba*, and *aaabb* are not.

3. (1 pt) Write an attribute grammar whose BNF basis is that of Example 3.6 in Section 3.4.5 but whose language rules are as follows: Data types cannot be mixed in expressions, but assignment statements need not have the same types on both sides of the assignment operator.

4. (2 pts) Compute the weakest precondition for the following sequences of statements:

a. `if (a != 3) a = 2*a-1; else a -= 2;` **{ a > 0 }**

b.
```
a = 3 * (2 * b + a);
b = 2 * a - 1
```
{b > 5}

c.
```
a = 3 * (a + b);
b = 5 * a – 2;
```
{b >= 4}

d.
```
a = 2 * b^2 + 1
b = a – 3
```
{b<0}

e. Prove that the following program is correct:

```
{n > 0}
count = n;
sum = 0;
while count <> 0 do
   sum = sum + count;
   count = count + 1;
end

{sum = 1 + 2 + … + n}
```

5. (2.5 pts) Given the following grammar

<stmt> → <id> = <expr>
<expr> → <expr> + NUM | <expr> - NUM | NUM
<id> → A | B | C

Write the recursive-descent parser for the above grammar. Then implement a complete parsing program in C or C++ programming language. Feel free to use the lexer from your text in your parser implementation, or you can assume that the lexer functions and is giving the parser one token at the time.

6. (1.5 pts) Given the following grammar

S → aAb | bBA
A → ab | aAB
B → aB | b

a) Show rightmost derivation of a sentence **`aaabbb`**.

b) Draw a parse tree for and show all of the *phrases* and the *handles*, for the following sentential forms :

i) **`aaabbb`**
ii) **`aaAbb`**
iii) **`bBab`**

c) Is the above grammar ambiguous? Justify your answer (if no, explain why; if yes, then provide an equivalent non-ambiguous grammar.

7. (1 pts) Chapter 4 Problem Set, Problem 8.

Turn In Procedures:

You may turn in your assignment via email (bkerkez@ashland.edu) or in person: on paper or on any computer media. If you wish to turn in your assignment via email, your file name should be in the format

***lastName_FirstName*_AssignmentX.xxx**

For example, John Smith's assignment 3 turn in file would be named "Smith_John_Assignment3.xxx".

If you chose to turn in your assignment via email, please make sure that you send your email via AU email system, and that the subject of the email message reads "**CS304_Assignment**". Please print a paper copy of your assignment and turn it in as well.

Please make sure that I receive your assignments before the due date and time. Late assignments will be accepted for 24 hours after they are due and will be penalized by a 50% deduction. No assignments will be accepted after the 24 hour period expires.