Georgia State University
Department of Computer Science

CSC4330/6330 – Assignment #3
Summer 2017
Due Sunday July 16th , 11:59 pm

All answers must be computer-printed, except for diagrams. Use your own words; do not copy material verbatim from a web site or other source.

1. Draw a state diagram to recognize floating-point constants in C, which are defined by the following EBNF rules:

<float-constant> → <fract-constant> [<exponent>] [<float-suffix>]
    | <digit-sequence> <exponent> [<float-suffix>]
<fract-constant> → [<digit-sequence>] . <digit-sequence>
    | <digit-sequence> .
<exponent> → e [<sign>] <digit-sequence>
    | E [<sign>] <digit-sequence>
<sign> → + | -
<digit-sequence> → <digit> | <digit-sequence> <digit>
<digit> → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
<float-suffix> → f | l | F | L

Use as few states as possible. States that are legal ending points for floating-point constants should be drawn as double circles (see the states labeled "id" and "int" in Figure 4.1 of Sebesta). To save space, omit the "addchar; getChar" labels and "return" actions shown in Sebesta's diagrams. You may use the name Digit to represent the characters listed in the <digit> rule and Suffix to represent the characters in the <float-suffix> rule.

2. Using the syntax of C, write a recursive descent subprogram that corresponds to the following EBNF production (taken from the specification of Java):

<local_variable_declaration_statement> →
    [final] <type> <variable_declarator> { , <variable_declarator> } ;

{, }, [, and] are metasymbols. Assume that the token codes for final, the comma, and the semicolon are FINAL_CODE, COMMA_CODE, and SEMICOLON_CODE, respectively. Also assume that recursive-descent subprograms named type and variable_declarator already exist.

3. Use the algorithm described in Section 4.4.2 of Sebesta to remove direct left recursion from the following grammar:

S → Sa | a | SA | b
A → bA | aS

4. The following questions refer to the grammar shown below.

S → aAb | bBA
A → ab | aAB
B → aB | b

(a) Give a <u>rightmost</u> derivation of the sentence babaabb.

(b) List all phrases in the sentence babaabb.

(c) List all simple phrases in the sentence babaabb.

(d) What is the handle of the sentence babaabb?

5. Perform the pairwise disjointness test for the following grammar rules.

(a) A → aB b cBB
(b) B → aB bA aBb
(c) C→ aaA b caB

6. Show a complete parse, including the parse stack contents, input string, and action for the string id + (id * id), using the grammar and parse table in Section 4.5.3 of Sebesta.

7. Indicate when each of the following bindings takes place in Python (language design time, language implementation time, compile time, link time, load time, or run time). If more than one time is possible, choose the latest possible time.

(a) Binding of the plain integer type to a specific number of bytes (i.e., the decision to use a specific number of bytes to store a plain integer value)

(b) Binding of a variable to a specific type

(c) Binding of the * operator to a particular operation

(d) Binding of an operator to a particular associativity (left or right)

8. (a) Variables can be divided into four categories: *static*, *stack-dynamic*, *explicit heap-dynamic*, and *implicit heap-dynamic*. For each variable in the C++ program below, specify which category it belongs to. Include both named variables and anonymous variables in your answer.

```
#include <iostream>
using namespace std;

int n;

int sum(int a[], int n);

int main(void)
{
  int i;

  cout << "Enter number of integers to be summed: ";
  cin >> n;

  int *a = new int[n];

  for (i = 0; i < n; i++) {
    cout << "Enter an integer: ";
    cin >> a[i];
  }

  cout << "The sum is " << sum(a, n) << endl;
  cout << "The sum is " << sum(a, n) << endl;

  return 0;
}

int sum(int a[], int n) {
  static int total = 0;

  for (int j = 0; j < n; j++)
    total += a[j];

  return total;
}
```

(b) The following example shows what the user will see when the program is executed:

```
Enter number of integers to be summed: 3
Enter an integer: 5
Enter an integer: 7
Enter an integer: 11
The sum is 23
The sum is 46
```

Why is the sum incorrect when it is displayed for the second time?

Submission Instructions:

- **Make sure to justify all answers – show all work.**
- The Assignment must be submitted electronically through ICollege/D2L.
- Upload the answers in a pdf file to ICollege/D2L in the respective assignment dropbox.
- All work must be neat and legible. Illegible work will receive no credit. This includes work where the print contrast or darkness are too faint
- The work that you turn in must be your own --- copying is not allowed for any assignments.
- Using another student's work as your own, allowing another student to use your work as their own, is academic misconduct and is not tolerated.