Homework 3

Programming Language Concepts

Due November 6, 2020

Name: _____

1. (15 points) Consider the following skeletal C program:

```
void fun1(void); /* prototype */
void fun2(void); /* prototype */
void fun3(void); /* prototype */

void main() {
   int a, b, c;
   . . .
}
void fun1(void) {
   int b, c, d;
   . . .
}
void fun2(void) {
   int c, d, e;
   . . .
}
void fun3(void) {
   int d, e, f;
   . . .
}
```

Given the following calling sequences and assuming that dynamic scoping is used, what variables are visible during execution of the last function called? Include with each visible variable the name of the function in which it was defined.

a. main calls fun1; fun1 calls fun2; fun2 calls fun3.

b. main calls fun1; fun1 calls fun3.

c. main calls fun2; fun2 calls fun3; fun3 calls fun1.

d. main calls fun3; fun3 calls fun1.

e. main calls fun1; fun1 calls fun3; fun3 calls fun2.

f. main calls fun3; fun3 calls fun2; fun2 calls fun1.

e. main calls fun2; fun2 calls fun1; (fun1 calls fun3) OR (fun3 calls fun1).

g. main calls fun2; fun2 calls fun1.

2. (15 points) Consider the following skeletal python program:

```
a = 15;
x = 1;
y = 3;
z = 5;
def sub1():
    a = 7;
    y = 9;
    z = 11;
    . . .
def sub2():
    global x;
    a = 13;
    x = 15;
    w = 17;
    . . .
    def sub3():
        nonlocal a;
        a = 19;
        b = 21;
        z = 23;
        ...
...
```

   List all the variables, along with the program units where they are declared, that are visible in the bodies of sub1, sub2, and sub3, assuming static scoping is used.

3. (15 points) Write a JavaScript script that has subprograms nested three deep and in which each nested subprogram references variables defined in all of its enclosing subprograms.

4. (10 points) Repeat exercise 3 with Python.

5. (15 points) Write an EBNF rule that describes the while statement of Java or C++. Write the recursive-descent subprogram in Java or C++ for this rule.

6. (10 points) Write a simple assignment statement with one arithmetic operator in some language you know. For each component of the statement, list the various bindings that are required to determine the semantics when the statement is executed. For each binding, indicate the binding time used for the language.

7. (10 points) Dynamic type binding is closely related to implicit heap-dynamic variables. Explain this relationship.

8. (10 points) Describe a situation when a history-sensitive variable in a subprogram is useful.

 _____ 85 points