CMPSC 461: Programming Languages Concepts

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Homework 3: **Due on Feb 28th class (12:20pm) in Canvas.**

Submission: Please submit your homework via Canvas. It's okay if you submit a scanned version of your on-paper answers, but please make sure your scanned version is legible.

1. (6 points) Consider the following function written in C:

```c
int x=1, y=2, z=3;
void foo(int a, int b) {
  a = a + b;
  x = x + a;
}
```

In each of the cases below, write down the values of x, y and z after the following calls to foo(). If necessary, assume that output arguments are copied back to parameters in the left-to-right order.

   (a) foo(y,z) where all parameters are passed by value

   (b) foo(y,z) where all parameters are passed by reference

   (c) foo(y,z) where all parameters are passed by value-result

   (d) foo(x,y) where all parameters are passed by reference

   (e) foo(x,y) where all parameters are passed by value-result

   (f) foo(x,x) where all parameters are passed by reference

2. (2 points) Consider the following C++ program, where `&i` means i is passed by reference:

```cpp
int bar (int &i) {
  i = i + 2;
  return 2 * i;
}
void foo1 () {
  int x = 2, y = 7, sum;
```

```
    sum = x;
    sum = sum + bar(x);
  }
  void foo2 () {
    int x = 2, y = 7, sum;
    sum = bar(x);
    sum = sum + x;
  }
```

   (a) What is the value of sum at the end of the function foo1? Briefly explain why.

   (b) What is the value of sum at the end of the function foo2? Briefly explain why.

3. (4 points) Consider the Ada program given below.

```
1   procedure Main is
2      A, B : Integer;
3      procedure Sub1 (C: Integer) is
4         D : Integer;
5      begin —— of Sub1
6         ...
7      end; —— of Sub1
8      procedure Sub2 (E: Integer) is
9         procedure Sub3 (F: Integer) is
10           B, D: Integer;
11        begin —— of Sub3
12           Sub1 (100);
13        end;   —— of Sub3
14      begin —— of Sub2
15         Sub3 (E);
16      end; —— of Sub2
17   begin —— of Main
18      Sub2 (10);
19   end; —— of Main
```

Ada is a statically scoped language. In the above program, the Main function invokes Sub2; Sub2 invokes Sub3; and Sub3 invokes Sub1. Draw the stack of activation records when the program's execution reaches before line 12 and line 6. For each activation record, include

local variables, parameters, the dynamic link, the static link, and the return address.