CS314 Spring 2017

March 29

Due Wednesday, March 29, 11:59pm

submission: pdf file through sakai.rutgers.edu

Probem 1 – Lexical Scoping Code Generation

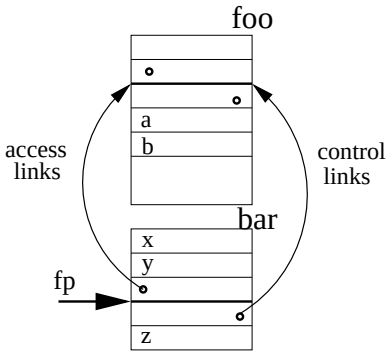
Assume that all variables are lexically scoped.

```
program main()
{    int a, b;
     procedure f()
     {  int c;
        procedure g()
        {
           ... = b + c    //<<<-------- (*A*)
           print a,b,c;
           end g;
        }
        a = 0; c = 1;
        ... = b + c    //<<<-------- (*B*)
        call g();
        print c;
        end f;
     }
     procedure g()
     {  int a,b;
        a = 3; b = 7;
        call f();
        print a,b;
        end g;
     }
  a = 2;  b = 3;
  print a,b;
  call g();
  print a,b;
  end main;
}
```

1. Show the runtime stack with its stack frames, access and control links, and local variables when the execution reaches program point `(*A*)`.

2. Give the ILOC RISC code for the expressions at program points (*A*) and (*B*). The value of the expressions need to be loaded into a register. The particular register numbers are not important here.

Problem 2 – Parameter Passing




```
program foo()
 {    a, b integer;
      procedure bar(integer x, integer y)
      {  z: integer;
                          <----- /* 0 */
         z = 3;                  /* 1 */
         x = x + y + z;          /* 2 */
         y = 1;                  /* 3 */
      }
      // statement body of foo
      a = 2;
      b = 5;
      call bar(a, b);
      print a, b; }
```

Use the RISC machine instructions `load, loadI, loadAI, storeAI, add` to show the code that needs to be generated for the body of procedure bar (statements (/*1*/ through /*3*/). Assume that

1. Register $r0$ contains the frame pointer (fp) value.
2. Formal parameter `x` is **call-by-reference**, and formal parameter `y` is **call-by-value**. Assume that bar's parameters `x` and `y` have been correctly initialized as part of the procedure call of bar.
3. Use the stack frame layout as shown above. The figure shows the runtime stack when the program execution reaches program point /*0*/ in procedure bar.

What values for `a` and `b` does the program print?

Problem 3 – Parameter Passing

Assume that you don't know what particular parameter passing style a programming language is using. In order to find out, you are asked to write a short test program that will print a different output depending on whether a *call-by-value*, *call-by-reference*, or *call-by-value-result* parameter passing style is used. Your test program must have the following form:

```
program main()
 {    a integer;
      procedure foo(integer x)
      {
          // statement body of foo
      }

      // statement body of main
      a = 1;
      call foo(a);
      print a;
 }
```

The body of procedure *foo* must only contain assignment statements. For instance, you are not allowed to add any new variable declarations.

1. Write the body of procedure foo such that `print a` in the `main` program will print different values for the different parameter passing styles.

2. Give the output of your test program and explain why your solution works.