CS 415 Compilers: Problem Set 11

Problem — Lexical/Dynamic Scoping & Symbol Table

Assume variable names written as capital letters use dynamic scoping and variable names written as lower case letters use static (lexical) scoping. Assume that procedures return when execution reaches their last statement. Assume that all procedure names are resolved using static (lexical) scoping.

1. Show the activation tree for the execution of the program below.

2. Show the program with all lexically scoped variable names (lower case) replaced by their (level, offset) representation.
   Describe how these (level, offset) pairs could be computed by a compiler (explain data structure(s) and algorithm(s)).

3. Show the runtime stack when execution reaches the point marked (*1*), (*2*), (*3*), and (*4*) in the code. Make sure you label all the stack frames with the corresponding procedure names and include the allocated local variables (and their particular values) within the frame. Include all control links and access links between the activation records (stack frames).

4. Show the output of the entire program execution.
program main()
{
    int A, b;

    procedure f()
    {
        int c;
        procedure g()
        {
            int c;
            c = 30;
            print A,b,c; //<<<------- (*1*)
            end g;
        }
        print A,b;
        A = 0;
        b = 0;
        c = 0;
        //<<<------------ (*2*)
        call g();
        print c;
        end f;
    }
    procedure g()
    {
        int A,b;
        A = 5;
        b = 7;
        call f();
        print A,b; //<<<----------(*3*)
        end g;
    }
    A = 2;  b = 3;
    print A,b;
    call g();
    print A,b; //<<<----------(*4*)
    end main;
}