CSCI 324 Programming Languages—Homework #6

Due Wednesday April 6, 2022 at 11:59 PM.

- Before starting the assignment, review the parts of the syllabus about collaboration.
- Your answers and discussion log should be submitted as a single PDF file to moodle.

1. Consider the following Algol-Descendent-like skeletal program:

```
1   program main;
2   var x : integer;
3     procedure sub1;
4       procedure sub2;
5         procedure sub3;
6         var x : integer;
7         ...
8         end; { sub3 }
9       ...
10      end; { sub2 }
11    ...
12    end; { sub1 }
13      procedure sub4;
14      var x : integer;
15      ...
16      end; { sub4 }
17  ...
18  end. { main }
```

Assume that the execution of the program occurs as follows:

```
main calls sub4
sub4 calls sub1
sub1 calls sub2
sub2 calls sub3
```

(a) Assuming **static scoping**, state which declaration of `x` (reference the declaration by line #) is used for a reference to `x` in:

i. `sub1`
ii. `sub2`
iii. `sub3`
iv. `sub4`
v. `main`

(b) Repeat part (a) using **dynamic scoping**.

2. Consider the following program fragment (no "back door" reference is allowed):

```
program Main;
  var x, ct, z : integer;

  procedure P1;
     var a, ct : integer;

     procedure P2;
        var a, b, x : integer;
     begin ... end;  { P2 }

  begin ... end; { P1 }

  procedure P3;
     var b, y, ct : integer;

     procedure P4;
        var a, b : integer;
     begin ... end;  { P4 }

  begin ... end; { P3 }

begin ... end. { Main }
```

(a) Assuming **static scoping**,[1] list all of the variables in the form *procedure.variable*, where *procedure* is the name of the procedure declaring the variable (e.g., `P2.a` for variable "`a`" declared within procedure "`P2`") that are visible[2] in each of the bodies, `P1`, `P2`, `P3` and `P4`.

(b) Assuming **dynamic scoping** and the calling sequence:

```
Main calls P3;
P3 calls P4;
P4 calls P1;
P1 calls P2;
```

List all the variables visible in each of the bodies, `P1`, `P2`, `P3`, and `P4` using the same form as in part a (e.g., `P2.a`).

[1] The scope of a variable is the range of statements in which the variable is visible.
[2] A variable is visible if it can be referenced or assigned.