BBM 301 - Programming Languages - Fall 2020 Final Exam
January 18, 2021 – Part 2

Name: _____

Student ID number: _____

Please write your name, ID and following honor pledge:
"**On my honor, I pledge that I have neither given nor received any unauthorized assistance on this exam.** "

"I give permission that my camera recordings will be taken for identification purposes for BBM301 exam and I understand that these recordings will not be used for any other purposes".

and **sign** your answer sheet.

Open ended questions, total 37 pts

1- Prolog [12 pts]

You are given some information about a family.

Bob is the parent of David, Emily, John, and Mary.
Ann is the parent of David, Emily, John, and Mary.
Ann, Emily and Mary are female.
Bob, David and John are male.

a) **(2 pts)** Use the predicates male/1, female/1, parent/2 (where /1 and /2 represents unary and binary relations respectively) to describe the above facts in this family.

b) **(4 pts)** Create rules to describe brother, and mother relations. You can name these two rules as brother/2 and mother/2.

c) **(6 pts)** How would you query the database to retrieve the following information? Write the rules for the queries, and also write the corresponding answers.

i. Whose mother is the same with David's?

ii. Does Mary have a brother?

2- Prolog [5 pts]

Show the complete variable instantiations (replace the values of variables with ground terms) if the matching between the first term and the second term succeeds. Write "No" otherwise.

Example

Term 1: [1, 2, 3]

Term 2: [X | Y]

Instantiations

X = 1 Y = [2, 3]

a)

```
Term 1: p(X, r(X))
Term 2: p(q(f), Y)
```

X =

Y =

b)

```
Term 1: size([H1, H2 | T])
Term 2: size([[a, b, c], d, [e, f] ,g, h]).
```

H1 =

H2 =

T =

3- Scheme [10 pts]

Consider the following Scheme code to find the minimum of a list

```
(define listmin
  (lambda (lst)
    (if (null? lst)
        '()
        (if (null? (cdr lst))
            (car lst)
            (min (car lst)
                 (listmin (cdr lst)))))))
```

An example call and output would be

> (listmin '(5 3 1 2)) -> 1

Write a tail recursive version of this code.

4- Subprogram Implementation [10pts]

Given the following program,

```
function Main()
int x = 0, y = 1, z= 5;
    function A();
    int x = 4, z= 8;
        function P()
        begin
            print (x,y,z);              /*  POINT A */
        end;
        function B(y)
        int x = 2, w=1;
        begin
            C(P);
        end;
        function C(F);
        int y = 5, z = 1;
        begin
            F;
        end;
    begin
        y = 7;
        B(x);
    end.
begin
    A();
end.
```

Assuming *dynamic scoping* is implemented with the *shallow access* method, show the contents of stacks at Point A associated with all variable names.