Programming Language Lab. 4 (A 반)

4.1 Calculation of factorial(n) using recursive function.

1) Write an algorithm in pseudo code that calculates the factorial(n) in recursive structure.

   In recursive structure, factorial(n) is calculated as follows:

   factorial(n) = n × factorial(n-1), where $n \geq 0$

   factorial(0) = 1

   <Example>

   factorial(5) = 120

2) Write a C++ program that inputs one non-negative integer from standard input, calculates the factorial(n) using the recursive function, and displays the result. The recursive function should print out the n (argument) value at each recursive call.

4.2 Finding root of 2nd order linear equation using bi-section algorithm in a structure of recursive iteration.

1) Write an algorithm in pseudo code and a C++ program that finds a root of 2nd order linear equation, $f(x) = Ax^2 + Bx + C$, in the region of $[x_L, x_R]$ using bi-section algorithm in a structure of recursive iteration.

2) in Bi-section algorithm, the program checks whether there is any change of sign (from plus to minus or vice versa); if there is any change in sign, it means that the graph crosses the x-axis, and there is a root in the region.

3) the skeleton of recursive Bi-section algorithm is given as follows:

```
int main() {
      double A, B, C, $x_L$, $x_R$   from standard input device;
      x_left = $x_L$;   x_right = $x_R$ ; root = $-\infty$;
      root = Bi-section(A, B, C, x_left, x_right);
      print the root;
}
double Bi-section(double A, double B, double C, double x_left, double x_right)
{
      step 1. x_mid = (x_right + x_left) / 2
      step 2. if the interval, x_right - x_left, is shorter than epsilon ($\varepsilon$ = 0.00005), return the
           midpoint as root.
      step 3. if the function value at the mid-point, f(A,B,C,x_mid), is zero, return the
           midpoint as root.
      step 4. if   ( f(A, B, C, x_left) * f (A, B, C, x_mid) < 0 )
                        return( Bi-section(A, B, C, x_left, x_mid));
              else if   ( f(A, B, C, x_right) * f(A, B, C, x_mid) < 0 )
                        return( Bi-section(A, B, C, x_mid, x_right));
              else {
                    print "There is no root in this region (x_left, x_right)";
                    return ( 0.0 );
              }
}
double f(double A, double B, double C, double x) {
      return ($Ax^2$ + Bx + C);
}
```