CSE2202: Numerical Methods Lab
Online: 3 Section: A2
Time: 40 Minutes Total: 10

Note:
2 sets of problems are given for this online lab test.
Set A: All Possible Roots by Modified Bisection Method
Set B: Multiple Roots of Polynomial using Newtons Method.

- If you choose Set A you will get 20% penalty and for choosing Set B you will get no penalty.
- After completing your code you must upload you code and output in the given Google form link.
- Allocated time for Set A is 30 minutes and for Set C is 40 Minutes

Set A

Problem Statement: Determine the all possible real roots of the equation: $f(x) = x^3 - 7x^2 + 15x - 9 = 0$ using Modified Bisection Method. Employ initial guesses of x_{lower} = 0 and x_{upper} = 4 and iterate until the estimated error $€_a$ falls below a level of $€_s$ = 0.00001

ALGORITHM:

1. Enter lower limit x_{lower} and upper limit x_{upper} of the interval covering all the roots.
2. Decide the size of the increment interval $\Delta x = 0.1$
3. set $x_1 = x_{lower}$ and $x_2 = x_{lower} + \Delta x$
4. Compute $f_1 = f(x_1)$ and $f_2 = f(x_2)$
5. If $(f_1 * f_2)>0$,
   then the interval does not bracket any root and go to step 9
6. Compute $x_0 = (x_1 + x_2)/2$ and $f_0 = f(x_0)$
7. If $(f_1 * f_2)<0$
   then set $x_2 = x_0$
   Else set $x_1 = x_0$ and $f_1 = f_0$
8. If $|(x_2 - x_1)/x_2| < E$, then
   root = $(x_1+x_2) / 2$
   write the value of root
   go to step 9
   Else
   go to step 6
9. If $x_2 < x_{upper}$, then set $x_{lower} = x_2$ and go to step 3
10. Stop.

Tasks:

1. Write a program using Modified Bisection Method to locate the approximate roots of the function $f(x) = x^3 - 7x^2 + 15x - 9 = 0$with initial guesses [0, 4].
2. Use Horner's rule to perform all iterations of the Modified Bisection Method until the estimated error $€_a$ falls below a level of $€_s$ = 0.00001
3. Use appropriate functions from math header file.
4. Show the table with all iterations and approximate values. (You can count the step by adding 1 to a counting variable *i* in the loop of the program).

Sample Input/output:

```
Enter the degree of the equation: 3

Enter the coefficients of the equation: 1   -7  15  -9
Enter the initial values:

itr   Root No.   Value of Root
53      1           1.000004
73      2           2.999637
74      3           3.000370
```

Set B

Problem Statement: Determine the multiple real roots of the equation: $f(x) = x^4 + 3x^3 - 2x^2 - 12x - 8 = 0$ using Newton's Method. Employ initial guess of $x_1 = 1$ and iterate until the estimated error $€_a$ falls below a level of $€_s = 0.001$.

Algorithm:

1. Obtain degree and co-efficient of polynomial (n and a_i).
2. Decide an initial estimate for the first root (x_0) and error criterion, E.
   Do while n >1
3. Find the root using Newton-Raphson algorithm
   $x_r = x_0 - f(x_0) / f'(x_0)$
4. Root (n) = x_r
5. Deflate the polynomial using synthetic division algorithm and make the factor polynomial as the new polynomial of order n-1.
6. Set $x_0 = x_r$ [Initial value of the new root]
   End of Do
7. Root (1) = $- a0 / a1$
8. Stop

Tasks:

1. Write a program using Newton's Method to locate the approximate roots of the function $f(x) = x^4 + 3x^3 - 2x^2 - 12x - 8 = 0$ with initial guess 1.
2. Use Horner's rule to perform all iterations of the Newton's Method until the estimated error $€_a$ falls below a level of $€_s = 0.001$
3. Use synthetic division to deflate the polynomial at lower degree.
4. Use appropriate functions from math header file.
5. Show the table with all iterations and approximate values. (You can count the step by adding 1 to a counting variable *i* in the loop of the program).

Sample Input/output:

```
Enter the degree of the equation: 4

Enter the coefficients of the equation: 1   3    -2   -12   -8

Enter the intial value:1
itr 0    Root 1: -2.000851
itr 1    Root 2: -1.999148
itr 2    Root 3: -1.000001
itr 3    Root 4: 2.000000
```