Computer Engineering Department

MSKU

Activity

CENG 2010 Programming Language Concepts, Spring 2021

In this question you are asked to write a program which approximates the root of an arbitrary function on the given interval. We will use RF method that approximates the root of any function f using:

Formula 1:

$$r = \frac{x_0 * f(x_1) - x_1 * f(x_0)}{f(x_1) - f(x_0)}$$

given a function f(x) on any interval $[x_0, x_1]$ such that $f(x_0)*f(x_1)<0$. This approximation narrows down the interval in each iteration and continues while number of allowed iterations is not reached.

Formula 2:

$$\text{if} \quad f(x_0) * f(r) < 0, \quad \text{then} \quad x_1 = r \qquad \text{else} \quad x_0 = r$$

Now follow the below steps carefully:

1. Declare a file pointer for an output file as a global variable.
2. Write a function ***arb_func*** which gets a float value **x** as an argument. The function computes $\mathbf{x} * \mathbf{log10}(\mathbf{x}) - \mathbf{1.2}$ and *returns* this result.
3. Write a function ***rf*** which gets a float pointer **x**, float **x1**, float **x2**, float **fx0**, float **fx1** and integer pointer **itr** in order, while it *returns* *nothing*. This function:
    a. approximates a root using Formula 1 and assigns this result to its first argument: float pointer **x** using indirection.
    b. increments the value of **itr** by one using indirection.
    c. prints a message giving iteration number and currently approximated root (see sample output)
    d. outputs the same message to your output file.
4. Write a main function. Inside this function,
    a. declare 7 variables:
        i. **itr**: int // number of iterations
        ii. **maxitr:** int // number of allowed iterations
        iii. **x0**: float// interval start point
        iv. **x1**: float//interval end point

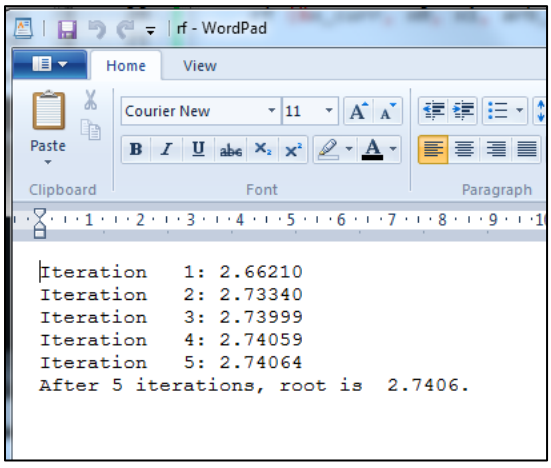
v. **x_curr**: float//currently computed root
vi. **x_next**: float//root in next step
vii. **error**: float// a very small number which is the maximum allowed error

b. Open your output file with write command “w”, and name your file as “rf.txt”
c. Ask the user to enter *x0*, *x1*, *error* and *maxitr* values (see sample output) and assign them to corresponding values
d. Initially, call **rf** function using *x_curr, x0, x1, arb_func(x0), arb_func(x1)* and *itr*.
e. Create a do-while loop. As a controlling expression, check whether *itr* is smaller than maximum number of allowed iterations. Inside loop body:
    i. Apply Formula 2 where r=x_curr in our case.
    ii. Call **rf** function using *x_next, x0, x1, arb_func(x0), arb_func(x1)* and *itr*.
    iii. if (fabs(x_next-x_curr) < error)
        1. You reached the root. Print a message and also output it to your file (see sample output).
        2. Return 0
    iv. Otherwise, continue and assign *x_next* to *x_curr*.
f. Outside the loop, print a message saying that you cannot converge and also output it to your file (see sample output)
g. close your file
h. return 1.

Sample Output:

```
Enter interval values [x0, x1], allowed error and number of iterations:
2 4 0.0001 10

Iteration 1: 2.66210
Iteration 2: 2.73340
Iteration 3: 2.73999
Iteration 4: 2.74059
Iteration 5: 2.74064
After 5 iterations, root is  2.7406.
```



```
Enter interval values [x0, x1], allowed error and number of iterations:
0 1 0.0001 10

Iteration 1: -1.#IND0
Iteration 2: -1.#IND0
Iteration 3: -1.#IND0
Iteration 4: -1.#IND0
Iteration 5: -1.#IND0
Iteration 6: -1.#IND0
Iteration 7: -1.#IND0
Iteration 8: -1.#IND0
Iteration 9: -1.#IND0
Iteration 10: -1.#IND0
Solution does not converge or iterations not sufficient:
```