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/*
Finding the real roots of any given equation using cheybesev method

Chebysav method is like approimating the given Transcedental Equation into a quadratic equation
 $f(x) = 0$ ,  $f(x) \sim a_0 + a_1x + a_2x^2$ 

Let  $x_k$  be an approximate root
 $f'(x) = a_1 + a_2x$ 
 $f''(x) = 2a_2$  by substituting the value  $x_k$  in all the equations we get the values of  $f(x_k)$ ,
 $f'(x_k)$ ,  $f''(x_k)$ 

we get,

$$f(x) \sim f_k + (x-x_k)f'_k + (x-x_k)^2 f''_k / 2 \implies 0$$


$$x_{k+1} = x_k - f_k / f'_k - (f_k^2 f''_k) / (2 (f'_k)^3)$$

*/

#include <stdio.h>
#include <stdlib.h>
#include <math.h>

//Function prototypes
float f(float x);
float df(float x);
float ddf(float x);
float chebyshev(float guess);

int main()
{
    float root, guess;

    //Making a guess
    printf("Enter guess: ");
    scanf("%f", &guess);

    //Invoking Function
    root = chebyshev(guess);
    printf("Root of the equation is: %f\n", root);

    exit(0);
}

float chebyshev(float guess)
{
    float root, a;
    a = guess;

    //Loop infinitely
    while (1)
    {
        root = a - (f(a)/df(a)) - (f(a)*f(a)*ddf(a))/(2*df(a)*df(a)*df(a));
        //root = a - (fa/fa_d) - (fa*fa*fa_d_d)/(2*fa_d*fa_d*fa_d);

        //Checking the convergence of the equation
        if (floor(a*10000) == floor(root*10000))
        {
            return root;
        }
        a = root;
    }
    return root;
}

float f(float x)
{
    float ans; //Declaration of variables in float

    ans = 3*x - cosf(x) - 1; // f(x)
    if(ans != ans)

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{
    printf("Cannot proceed further..Try changing the guess\n");
    exit (3);
}
return ans; //Returning the value of f(x) at x1
}

float df(float x)
{
    float ans; //Declaration of variables in float

    ans = 3 + sinf(x); // f'(x)
    if(ans != ans)
    {
        printf("Cannot proceed further..Try changing the guess\n");
        exit (4);
    }
    return ans; //Returning the value of f'(x) at x1
}

float ddf(float x)
{
    float ans; //Declaration of variables in float

    ans = cosf(x); // f''(x)
    if(ans != ans)
    {
        printf("Cannot proceed further..Try changing the guess\n");
        exit (4);
    }
    return ans; //Returning the value of f'(x) at x1
}
```