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/*
This program finds the roots of any equation by using bisection method. In this method an interval [a, b] is taken initially and checks if f(x) has any roots or not. If  $f(a) \cdot f(b) < 0$  then f(x) has atleast one root. Then the interval is bisected at a point  $m = (a+b)/2$  and if  $f(a) \cdot f(m) < 0$ , then the interval is updated as [a, m], else the interval is updated as [m, b], and the process goes on.....

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Finally we find m such that $m = a/2 = b/2$. That is the point of convergence of f(x).

Input: -Limits of the initial interval i.e a, b.
 -Any function F(x)

ALGORITHM:

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step-1: Assume that a root of f(x) lies in the interval I = [a, b].
step-2: Bisect the interval I at  $m = (a + b)/2$ 
step-3: Now update interval I as I = [a, m] if  $f(a)f(b) < 0$ ; if not then update I as I = [m, b]
And it goes on.....

```

Output: -Root(s) of F(x).
 */

```

#include <stdio.h> //Includes standard I/O libraries
#include <stdlib.h> //Includes standard libraries
#include <math.h> //Includes maths functions

```

```

//Function prototypes
float f(float val); //Returns the function value
void bisection(float a, float b);

```

```

//Main function starts here
int main()
{
//Declaration of variables
float a, b;
//a - Lower boundary of the interval
//b - Upper boundary of the interval

```

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//Getting the values of a
printf("Enter a: ");
scanf("%f", &a);

```

```

//Getting the values of b
printf("Enter b: ");
scanf("%f", &b);

```

```

bisection(a, b); //Calling bisection function

exit (0);
}

```

```

void bisection(float a, float b)
{
int i = 0; //To record the number of iterations taken by the program
float m; //Mid point of a and b
float x, y; //Used to store the rounded values of a and b

```

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//Calculating f(a)f(b) to check if the equation has roots in the given interval
if(f(a)*f(b) >= 0)
{
printf("The function has no solutions in the given interval\n");
exit (1);
}

```

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//Loop infinitely
while(1)

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```
{
    m = (a + b)/2; //Bisecting the interval

    //Checking if m is a root of the equation
    if(f(m) == 0)
    {
        printf("Root %f found after %d iterarions\n", m, i);
        break;
    }

    //Shriking the interval
    //If f(a)f(m) is -ve, then root exists in the interval [a, m]
    if(f(a)*f(m) < 0)
    {
        b = m;
    }
    //If f(a)f(m) is +ve, then root exists in the interval [m, b]
    else
    {
        a = m;
    }

    //Checking if the equation is converged
    //We can check a == b directly but here
    //a and b will get rounded off upto 5 digit accuracy
    //to avoid infinite looping

    //Round off the values of a and b to 5 digit accuracy
    x = round(a*100000)/100000;
    y = round(b*100000)/100000;
    if(x == y)
    {
        printf("Root %f found after %d iterarions\n", a, i);
        break;
    }
    i++; //update the number of iteration
}

exit (0);
}

//Evaluting the function value
float f(float val)
{
    float ans;
    //Calculating function value
    ans = val*log10f(val) - 1.2;
    return ans;
}
```