Date -
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PRACTICAL 1

- **Objective:** To write a C++ program to find the root of the equation ($x^3 - 4x - 5$) using Bisection method.

- **Algorithm:**

1. Calculate approx. root for every iteration using $x_i = (a + b) / 2$
2. Display the approx. root for every iteration.
3. Calculate f(a).f(x1)
    a. If f(a).f(x1) < 0, then a = a, b = x1 (exact root lies between a and x1).
    b. If f(a).f(x1) > 0, then a = x1, b = b (exact root lies between x1 and b).
4. If |x1 - x| lies within the given acceptable error, then display x1 as root.
5. If the no. of iterations exceed the no. of max. iterations, then display solution doesn't converge and the given max. iterations are not sufficient.

- **Practical Code:**

```
#include <iostream>
#include <iomanip>
#include <math.h>
using namespace std;

float f(float x) {
   return (x*x*x-4*x-9);
}
void bisect(float *x, float a, float b, int *itr) {
   *x = (a + b)/2 ;
   ++(*itr);
   cout << "Iteration no. " << *itr << ", x = " << *x << endl;
}

int main() {

   int itr = 0, maxitr;
   float x, a, b, aerr, x1;

   cout << "\nEnter the values of a, b, allowed error, maximum iterations : " << endl;
   cin >> a >> b >> aerr >> maxitr;

   bisect(&x1, a, b, &itr);
   do {
      if (f(a) * f(x) < 0) b = x;
      else a = x;
      bisect(&x1, a, b, &itr);
      if (fabs(x1-x) <aerr) {
```

```
            cout << "\nAfter " << itr << " iterations, root " << "= " << setprecision(4) << x1 << endl;
            return 0;
        }
        x = x1;
    } while (itr<maxitr);
    cout << "Solution does not converge, " << itr << " iterations not sufficient" << endl;

    return 1;
}
```

- **Output:**

```
Enter the values of a, b, allowed error, maximum iterations :
2 3 0.01 15
Iteration no. 1, x = 2.5
Iteration no. 2, x = 1.5
Iteration no. 3, x = 2.25
Iteration no. 4, x = 2.625
Iteration no. 5, x = 2.8125
Iteration no. 6, x = 2.71875
Iteration no. 7, x = 2.67188
Iteration no. 8, x = 2.69531
Iteration no. 9, x = 2.70703
Iteration no. 10, x = 2.70117

After 10 iterations, root = 2.701
```

- **Application:**
  a. Used to detect short segments in video content for a digital video library.
  b. Used to determine the appropriate population size.
  c. Used to locate and compute periodic orbits in a molecular system.

- **Viva questions:**

Q1. Define transcendental equations.

A1. An equation containing polynomials, logarithmic, trigonometric, and exponential functions is known as transcendental equation.

Q2. What is the difference b/w Algebraic and Transcendental equations?

A2. The equations of the form f(x) = 0 where f(x) is purely a polynomial in x is called an algebraic equation. But, if f(x) involves trigonometrical, arithmetic or exponential terms in it, then it is called transcendental equation.

Q3. Write the methods that can be used to solve transcendental equations.

A3. Methods include –

a. Bisection Method (Bolzano Method)
b. Regula Falsi Method (False position method)
c. Newton-Raphson Method
d. Secant Method

Q4. Can the methods of solving transcendental equations also solve algebraic equations?

A4. Yes, algebraic equations can be solved using methods used to solve transcendental equations.

Q5. What is the rate of convergence of bisection method?

A5. Linear.

Q6. Formula for finding the no. of iterations in bisection method.

A6. $n \geq [(\log(b-a) - \log\epsilon) / \log 2]$ [n = no. of iterations]

Q7. Which method out of Newton Raphson and Bisection method is faster?

A7. Newton Raphson Method is faster.

Q8. Write the statement of intermediate value theorem.

A8. The intermediate value theorem states that if f(x) is a continuous function whose domain contains the interval [a, b], then it takes on any given value between f(a) and f(b) at some point within the interval.

This implies that, if a continuous function has values of opposite sign inside an interval, then it has a root in that interval.

Q9. What is the meaning of root of an equation?

A9. The value which satisfies an equation is known as its root.

Q10. What is the other name of bisection method?

A10. Bolzano Method.