

International Islamic University Chittagong (IIUC)
Department of Computer Science Engineering (CSE)

LAB - 1

Course title : Numerical Methods Lab

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Submitted To:

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1. Write a program to count the number of significant digits in a given number.

```
#include<bits/stdc++.h>
using namespace std;

int trapCheck(int n, string c)
{
    int frontDigit = 0;
    int backDigit = 0;
    int ans = 0;
    for(int i = 0; i < n; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            frontDigit++;
            //cout << "TP f" << frontDigit << endl;
        }
    }
    for(int i = n; i < c.size() ; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            backDigit++;
            //cout << "TP b" << backDigit << endl;
        }
    }

    if(frontDigit > 0 && backDigit > 0)
    {
        ans = 1;
    }
    //cout << "TP ans" << ans << endl;

    return ans;
}

int endCheck(int n, string c)
{
    int frontDigit = 0;
    int backDigit = 0;
    int ans = 0;
    for(int i = 0; i < n; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            frontDigit++;
            //cout << "TR f" << frontDigit << endl;
        }
    }
    for(int i = n; i < c.size() ; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            backDigit++;
            //cout << "TR b" << backDigit << endl;
        }
    }

    if(frontDigit > 0 && backDigit == 0)
    {
        ans = 1;
    }
}
```

```

    }
    //cout << "TR ans" << ans << endl;

    return ans;
}

int startCheck(int n, string c)
{
    int frontDigit = 0;
    int backDigit = 0;
    int ans = 0;
    for(int i = 0; i < n; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            frontDigit++;
            //cout << "LE f" << frontDigit << endl;
        }
    }
    for(int i = n; i < c.size() ; i++)
    {
        if(c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            backDigit++;
            //cout << "LE b" << backDigit << endl;
        }
    }

    if(frontDigit == 0 && backDigit > 1)
    {
        ans = 1;
    }
    //cout << "LE ans" << ans << endl;

    return ans;
}

int countSignificantFigures(string c)
{
    /*for (int i=0;i<c.size();i++)
    {
        cout << c[i] ;
    }
    cout << endl;*/

    int count = 0;
    int trappedZeros = 0, leadingZeros = 0, trailingZeros = 0, trail = 0;

    bool counting = false;

    // Iterate through each character in the string
    for (int i = 0; i < c.size(); i++)
    {
        if (c[i] == '1' || c[i] == '2' || c[i] == '3' || c[i] == '4' || c[i] == '5' ||
c[i] == '6' || c[i] == '7' || c[i] == '8' || c[i] == '9')
        {
            //cout << c[i] << endl;
            //cout << count << endl;
            count++;
            //cout << count << endl;
        }
        else if (c[i] == '.')
        {
            // Decimal point encountered, reset counting flag

```

```

        counting = true;
    }
    else if (c[i] == '0')
    {
        //cout << c[i] << endl;
        if (trapCheck(i, c) == 1)
        {
            trappedZeros++;
            //cout << "TP" << trappedZeros << endl;
        }
        else if(endCheck(i, c) == 1)
        {
            trailingZeros++;
            //cout << "TR" << trailingZeros << endl;
        }
        else if(startCheck(i, c) == 1)
        {
            leadingZeros++;
            //cout << "LE" << leadingZeros << endl;
        }
    }
}

int ans;
if(counting)
{
    ans = count + trappedZeros + trailingZeros;
}
else
{
    ans = count + trappedZeros + trail;
}

return ans;
}

int main()
{
    ///Peace be with you.
    //optimize();

    string number;
    cout << "Enter a number: ";
    getline(cin, number);

    int significantDigits = countSignificantFigures(number);
    cout << "The number of significant digits is: " << significantDigits << endl;

    return 0;
}

```

LINK : <https://onlinegdb.com/yasGbMKKAT>

2. Write a program to round off a number with n significant figures using banker's rule.

```
#include<bits/stdc++.h>
using namespace std;

int main()
{
    ///Peace be with you.

    string number;
    string output = "";
    cout << "Enter the number: ";
    getline(cin, number);

    int n;
    cout << "Enter Nth significant value: ";
    cin >> n;

    int decPoint;

    for (int i = 0; i < number.size(); i++)
    {
        if(number[i] == '.')
        {
            decPoint = i+1;
            //cout << decPoint << endl;
            break;
        }
    }

    int End = decPoint + n;
    //cout << End << endl;

    string result = "";
    for(int i = 0; i < End; i++)
    {
        result += number[i];
        //cout << result << endl;
    }
    //cout << result << endl;

    int count = 0;

    if((number[End] - '0') < 5)
    {
        result[End - 1] = number[End - 1];
    }
    else if((number[End] - '0') > 5)
    {
        int ans = (number[End - 1] - '0') + 1;
        //cout << ans << endl;
        string change = to_string(ans);
        //cout << change << endl;
        result.replace(End - 1, result[End - 1], change);
    }
    else if((number[End] - '0') == 5)
    {
        if((number[End - 1] - '0') % 2 == 0)
        {
            result[End - 1] = number[End - 1];
        }
        else
        {
            int ans = (number[End - 1] - '0') + 1;
            //cout << ans << endl;
        }
    }
}
```

```
        string change = to_string(ans);  
        //cout << change << endl;  
        result.replace(End - 1, result[End - 1], change);  
    }  
}  
  
cout << "Round off number: " << result << endl;  
  
return 0;  
}
```

LINK : <https://onlinegdb.com/aLffO4kh>

3. Write a program to evaluate a polynomial $f(x) = x^3 - 2x^2 + 5x + 10$ by using Horner's rule $x = 5$.

```
#include <iostream>
using namespace std;

int main()
{
    ///Peace be with you.

    int Order = 3;
    int a[Order+1] = {1, -2, 5, 10}; //  $x^3 - 2x^2 + 5x + 10$ 
    int x = 5;
    int p = a[0];

    for(int i = 1; i <= Order; i++)
    {
        p = x*p + a[i];
    }

    cout << p << endl;
    return 0;
}
```

LINK : <https://onlinegdb.com/myRN5SMYu>

4. Write a program to find the root of the equation $x^3 - 9x + 1 = 0$, correct to 3 decimal places, by using the bisection method.

```
#include<bits/stdc++.h>
using namespace std;

#define f(x) ((x*x*x) - (9*x) + 1) //  $x^3 - 9x + 1 = 0$ 

int main()
{
    ///Peace be with you.

    double a = -1.0, b = 1.0, tolerance = 0.0005;

    double c;
    while(1)
    {
        if(fabs(a-b) < tolerance)
        {
            break;
        }

        c = (a+b)/2;
        if (f(c)*f(a) < 0)
        {
            b = c;
        }
        else
        {
            a = c;
        }
    }

    cout<<"The value of root is = "<< c <<endl;

    return 0;
}
```

LINK : <https://onlinegdb.com/31Ya7yMVk>

5. Write a program to find the root of the equation $x^5 + 3x^2 - 10 = 0$, correct to 3 decimal places, by using the fixed point method.

```
#include<bits/stdc++.h>
using namespace std;

#define f(x) ((x*x*x*x*x) + (3*(x*x)) - 10) //  $x^5 + 3x^2 - 10 = 0$ 
#define g(x) (sqrt(10 / ((x*x*x) + 3))) //  $x = \sqrt{10 / (x^3 + 3)}$ 

int main()
{
    ///Peace be with you.

    double x0 = 0.0, x1, tolerance = 0.0005;

    while(1)
    {
        x1 = g(x0);

        if (fabs(x1 - x0) < tolerance)
        {
            break;
        }
        else
        {
            x0 = x1;
        }
    }
    cout << "The value of root is = " << x1 << endl;

    return 0;
}
```

LINK : <https://onlinegdb.com/5S9F8inP4>

6. Write a program to find the root of the equation $x^3 - 6x + 4 = 0$, correct to 3 decimal places, by using Newton-Raphson method.

```
#include<bits/stdc++.h>
using namespace std;

#define f(x) ((x*x*x) - (6*x) + 4) //  $x^3 - 6x + 4$ 
#define f2(x) ((3*x*x) - 6) //  $3x^2 - 6$ 

int main()
{
    ///Peace be with you.

    double x0 = 0.0, x1, tolerance = 0.0005;

    while(1)
    {
        x1 = (x0 - (f(x0)/f2(x0)));

        if (fabs(x1 - x0) < tolerance)
        {
            break;
        }
        else
        {
            x0 = x1;
        }
    }
    cout<<"The value of root is = "<< x1 <<endl;

    return 0;
}
```

LINK : https://onlinegdb.com/UuT_1vbAH

7. Write a program to find the root of the equation $x^3 - x + 2 = 0$, correct to 3 decimal places, by using the false position method.

```
#include<bits/stdc++.h>
using namespace std;

#define f(x) ((x*x*x) - (x) + 2) //  $x^3 - x + 2$ 

int main()
{
    ///Peace be with you.

    double x1 = 0.0, x2 = -2.0, x0, tolerance = 0.0005;

    while(1)
    {
        x0 = x1 - ((f(x1)*(x2-x1))/(f(x2)-f(x1)));

        if(fabs(x1-x2) < tolerance)
        {
            break;
        }

        if (f(x0)*f(x1) < 0)
        {
            x2 = x0;
        }
        else
        {
            x1 = x0;
        }
    }
    cout<<"The value of root is = "<< x0 <<endl;

    return 0;
}
```

LINK : <https://onlinegdb.com/vhXrz7Kas>

8. Write a program to find the root of the equation $x^3 - 5x^2 - 29 = 0$, correct to 3 decimal places, by using the secant method.

```
#include<bits/stdc++.h>
using namespace std;

#define f(x) ((x*x*x) - (5*x*x) - 29) //  $x^3 - 5x^2 - 29$ 

int main()
{
    ///Peace be with you.

    double x0 = 2.0, x1 = 4.0, x2, tolerance = 0.0005;

    while(1)
    {
        x2 = x0 - ((f(x0)*(x1-x0))/(f(x1)-f(x0)));

        if (fabs(x1 - x0) < tolerance)
        {
            break;
        }
        else
        {
            x0 = x1;
            x1 = x2;
        }
    }
    cout<<"The value of root is = "<< x2 <<endl;

    return 0;
}
```

LINK : <https://onlinegdb.com/KOepBt9PO>

9. Write a program to find the quotient polynomial $q(x)$ such that $p(x) = (x - 2) q(x)$ where the polynomial $p(x) = x^3 - 5x^2 + 10x - 8 = 0$ has a root at $x = 2$.

MISS THE CLASS.

10. Write a program to find all the roots of the equation $x^3 - 6x + 4 = 0$, correct to 3 decimal places.

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