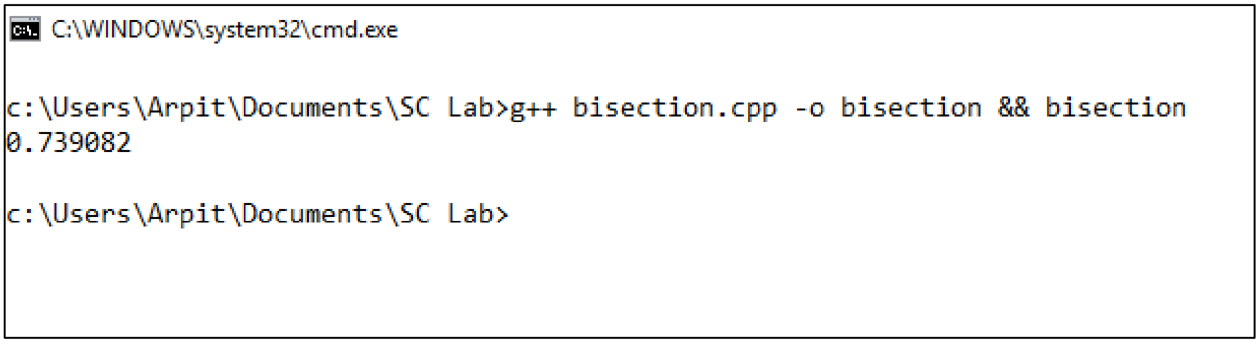
Experiment 1

AIM: To solve $x - \cos(x)$ using Bisection Method

```
#include <iostream>
#include <cmath>
using namespace std;
double function(double x) {
    return (x - cos(x));
}
int main() {
    double midx, function_mid, left, right, previous_function_mid;
    left = 0, right = 1;
    midx = (left + right) / 2;
    previous_function_mid = function(midx);
    while(true) {
        double value_at_left = function(left);
        double value_at_right = function(right);
        double value_at_mid = function(midx);
        if(value_at_mid * value_at_left < 0)
            right = midx;
        else
            left = midx;
        previous_function_mid = value_at_mid;
        midx = (left + right) / 2;
        if(abs(previous_function_mid) <= 0.00001)
            break;
    }
    cout << midx << "\n";
}
```

```
ANS = 0.739082
```



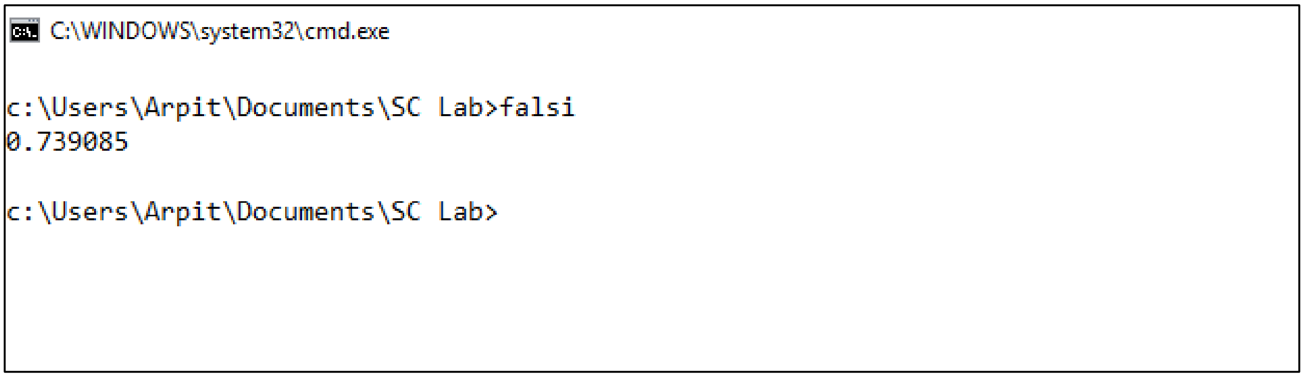
```
c:\Users\Arpit\Documents\SC Lab>g++ bisection.cpp -o bisection && bisection
0.739082

c:\Users\Arpit\Documents\SC Lab>
```

Experiment 2

AIM: To solve $x - \cos(x)$ using Regula Falsi Method.

```
#include <iostream>
#include <cmath>
using namespace std;
float f(float x) {
    return (x - cos(x));
}
int main() {
    float a = 0, b = 1;
    float x = 0, y = 0;
    while(true) {
        x = (a * f(b) -  b * f(a)) / (f(b) - f(a));
        if(f(a) * f(b) < 0)
            b = x;
        else
            a = x;
        if(y == x)
            break;
        y = x;
    }
```

ANSWER = 0.739085



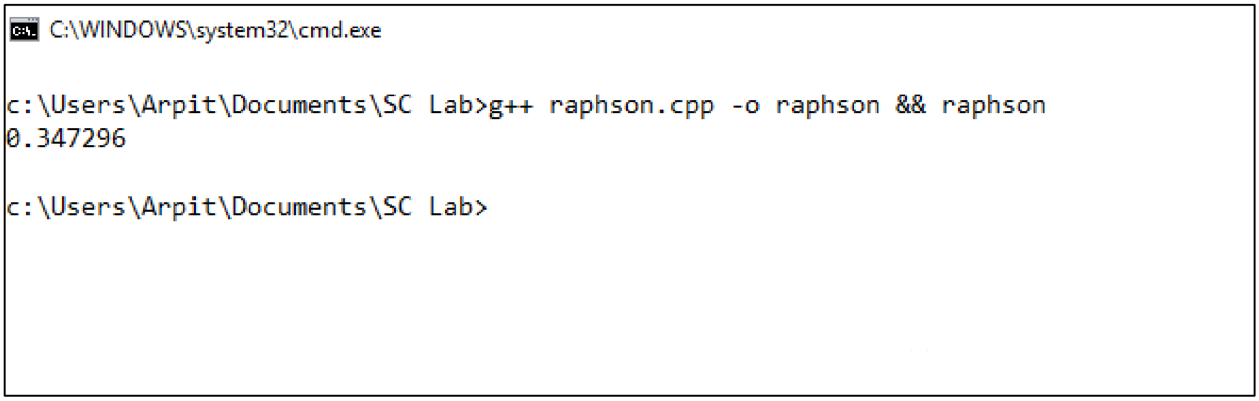
```
c:\Users\Arpit\Documents\SC Lab>falsi
0.739085

c:\Users\Arpit\Documents\SC Lab>
```

Experiment 3

AIM: To solve $x^3 - 3x + 1 = 0$ using Newton Raphson Method

```
#include <iostream>

#include <cmath>

using namespace std;

double function(double x) {

    return (pow(x, 3) - (3) * (x) + 1);

}

double derivative(double x) {

    return (3 * pow(x, 2) - 3);

}

int main() {

    double xn = 0, xn1;

    while(true) {

        xn1 = xn - (function(xn) / derivative(xn));

        if(xn1 == xn)

            break;

        xn = xn1;

    }

    cout << xn1 << "\n";

}
```

ANSWER = 0.347296



```
c:\Users\Arpit\Documents\SC Lab>g++ raphson.cpp -o raphson && raphson
0.347296

c:\Users\Arpit\Documents\SC Lab>
```

Experiment 4

AIM: To solve the given system of equations using Gauss Elimination Method

$$\mathbf{10x - 7y + 3z + 5t = 6}$$

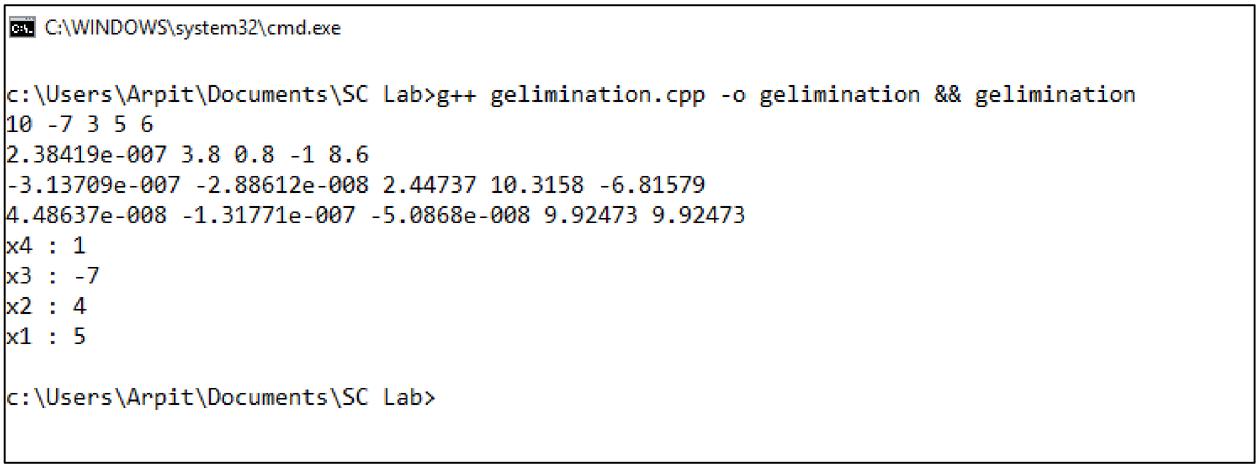
$$\mathbf{-6x + 8y - z - 4t = 5}$$

$$\mathbf{3x + y + 4z + 11 = 2}$$

$$\mathbf{5x - 9y - 2z + 4t = 7}$$

```
#include<iostream>
using namespace std;
void transform(float arr[4][5], int src, int dest, float factor){
    for(int i = 0 ; i < 5 ; i++)
        arr[dest][i] = arr[dest][i] + arr[src][i] * factor;
}

int main(){
    float arr[4][5] = {10, -7, 3, 5, 6,
                        -6, 8, -1, -4, 5,
                        3, 1, 4, 11, 2,
                        5, -9, -2, 4, 7};
    transform(arr, 0, 1, -arr[1][0] / arr[0][0]);
    transform(arr, 0, 2, -arr[2][0] / arr[0][0]);
    transform(arr, 0, 3, -arr[3][0] / arr[0][0]);
    transform(arr, 1, 2, -arr[2][1] / arr[1][1]);
    transform(arr, 1, 3, -arr[3][1] / arr[1][1]);
    transform(arr, 2, 3, -arr[3][2] / arr[2][2]);
    for(int i = 0 ; i < 4 ; i++){
        for(int j = 0 ; j < 5 ; j++)
            cout<<arr[i][j]<< " ";
        cout<<endl;
    }
    float fin[4];
    for(int i = 3 ; i >= 0 ; i--) {
        cout << "x" << (i + 1) << " : ";
        float ans = arr[i][4];
        for(int j = 0 ; j < 4 ; j++) {
            if(j != i)
                ans -= arr[i][j] * fin[j];
        }
        ans /= arr[i][i];
        fin[i] = ans;
        cout << ans << endl;
    }
    return 0;
}
```

ANS = (5, 4, -7, 1)



```
c:\Users\Arpit\Documents\SC Lab>g++ gelimination.cpp -o gelimination && gelimination
10 -7 3 5 6
2.38419e-007 3.8 0.8 -1 8.6
-3.13709e-007 -2.88612e-008 2.44737 10.3158 -6.81579
4.48637e-008 -1.31771e-007 -5.0868e-008 9.92473 9.92473
x4 : 1
x3 : -7
x2 : 4
x1 : 5

c:\Users\Arpit\Documents\SC Lab>
```

Experiment 5

AIM: To solve the system of equations sing Gauss Seidal Method

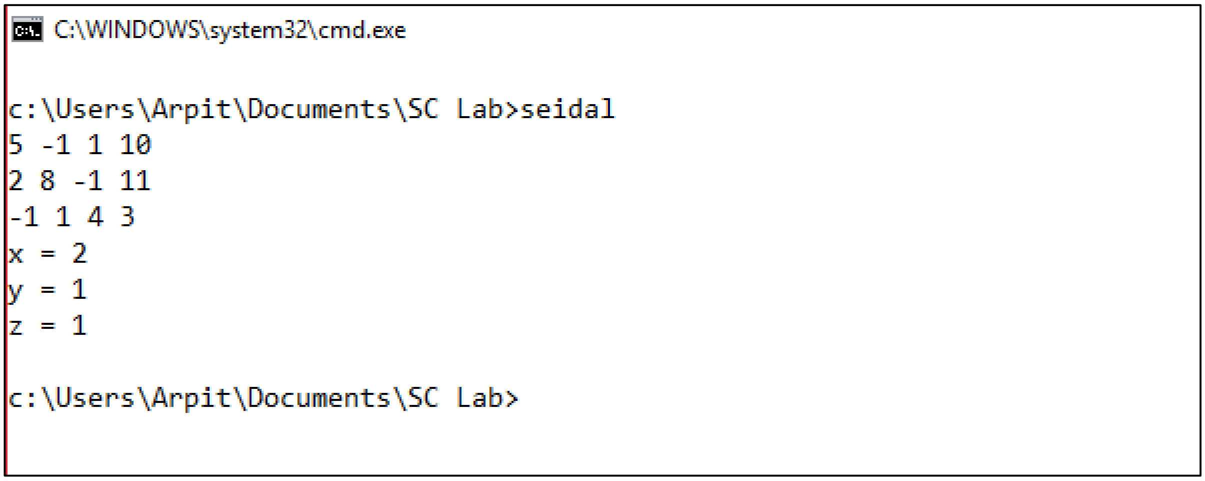
$$5x - y + z = 10$$

$$2x + 8y - z = 11$$

$$-x + y + 4 = 3$$

```
#include <iostream>
#include <vector>
#include <cmath>
using namespace std;
int main() {
    ios_base::sync_with_stdio(0);
    vector<vector<float> > matrix;
    matrix.resize(3, vector<float>(4));
    for(int i = 0 ; i < 3 ; i++)
        for(int j = 0 ; j < 4 ; j++)
            cin >> matrix[i][j];
    vector<float> ans(3, 0);
    bool pass = true;
    while(pass) {
        pass = false;
        for(int i = 0 ; i < 3 ; i++) {
            float val = matrix[i][3];
            for(int j = 0 ; j < 3 ; j++)
                if(i != j)
                    val -= matrix[i][j] * ans[j];
            val /= matrix[i][i];
            if(abs(val - ans[i]) > 0.00001)
                pass = true;
            ans[i] = val;
        }
    }
    cout << "x = " << ans[0] << "\n";
    cout << "y = " << ans[1] << "\n";

    cout << "z = " << ans[2] << "\n";

}
```

ANS = (2, 1, 1)



```
c:\Users\Arpit\Documents\SC Lab>seidal
5 -1 1 10
2 8 -1 11
-1 1 4 3
x = 2
y = 1
z = 1

c:\Users\Arpit\Documents\SC Lab>
```

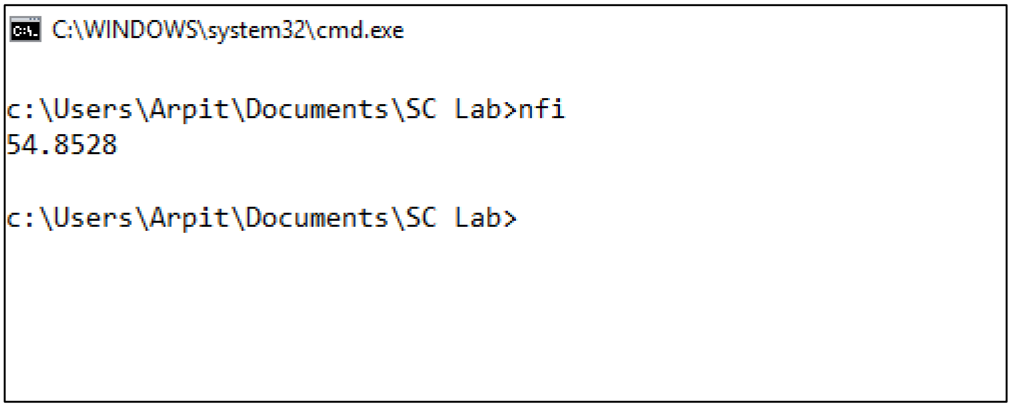
Experiment 6

AIM: Use Newton Forward Interpolation Formula to get value at x = 1895.

X	1891	1901	1911	1921	1931
Y	46	66	81	93	101

```
#include <iostream>
#include <vector>
using namespace std;
typedef float f;
vector<f> y;
f p = 0.4, n = 5, ans = 0;
float factorial(float n) {
    if(n <= 1)
        return 1;
    else
        return (n * factorial(n - 1));
}
void solve(float k) {
    if(k == n)
        return;
    float prod = y[0];
    for(int i = 0 ; i < k ; i++)
        prod *= (p - i);
    prod /= factorial(k);
    ans += prod;
    for(int i = 0 ; i < (n - k - 1) ; i++)
        y[i] = y[i + 1] - y[i];
    solve(k + 1);
}
int main() {
    y.resize(5, 0);
    y[0] = 46; y[1] = 66; y[2] = 81; y[3] = 93;

    y[4] = 101;

    solve(0);

    cout << ans << "\n";

}
```

ANS = 54.8528



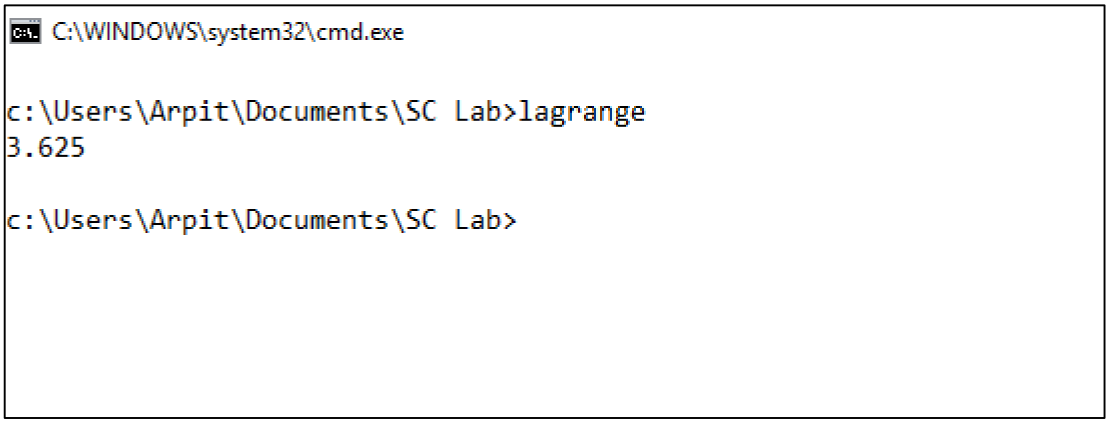
```
c:\Users\Arpit\Documents\SC Lab>nfi
54.8528

c:\Users\Arpit\Documents\SC Lab>
```

Experiment 7

AIM: Find the value of y at x = 9.5 using Lagrange's Method

X	7	8	9	10
Y	3	1	1	9

```
#include <iostream>
using namespace std;
float point = 9.5;
int x[] = {7, 8, 9, 10};
int y[] = {3, 1, 1, 9};
int main() {
    float answer = 0;
    for(int index = 0 ; index < 4 ; index++) {
        float term = y[index];
        for(int i = 0 ; i < 4 ; i++)
            if(index != i)
                term *= (point - x[i]) / (x[index] - x[i]);
        answer += term;
    }
    cout << answer << "\n";
}
ANS = 3.625
```



```
c:\Users\Arpit\Documents\SC Lab>lagrange
3.625

c:\Users\Arpit\Documents\SC Lab>
```

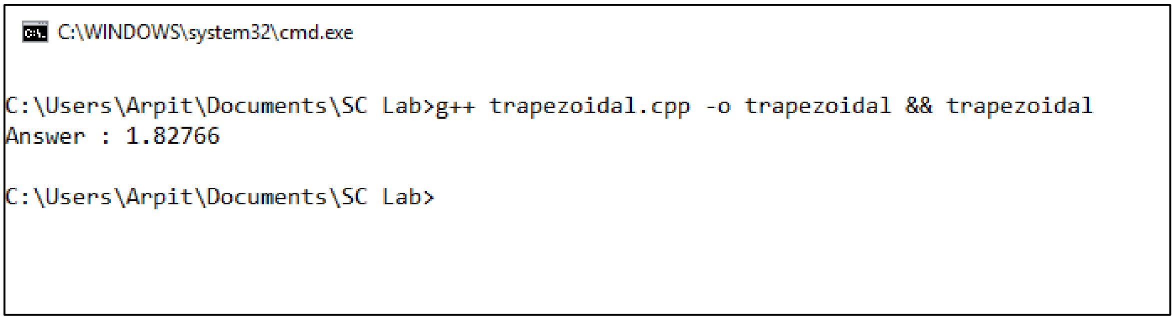
Experiment 8

AIM: Evaluate the integral using Simpson's 1/3rd Formula

$$\int_{4}^{5.2} \boldsymbol{log(x)}$$

```
#include <iostream>

#include <cmath>

using namespace std;

float h = 0.2, lower = 4, upper = 5.2;

double f(double x) {

    return log(x);

}

int main() {

    ios_base::sync_with_stdio(0);

    double x = lower + h, sum = 0;

    while(x < upper) {

        double temp = f(x);

        sum += temp;

        x += h;

        cout << sum << " " << x << "\n";

    }

    sum *= 2;

    sum += (f(lower) + f(upper));

    sum *= (h / 2);

    cout << "Answer : " << sum << "\n";

}
```

ANSWER : 1.82766



```
C:\Users\Arpit\Documents\SC Lab>g++ trapezoidal.cpp -o trapezoidal && trapezoidal
Answer : 1.82766

C:\Users\Arpit\Documents\SC Lab>
```

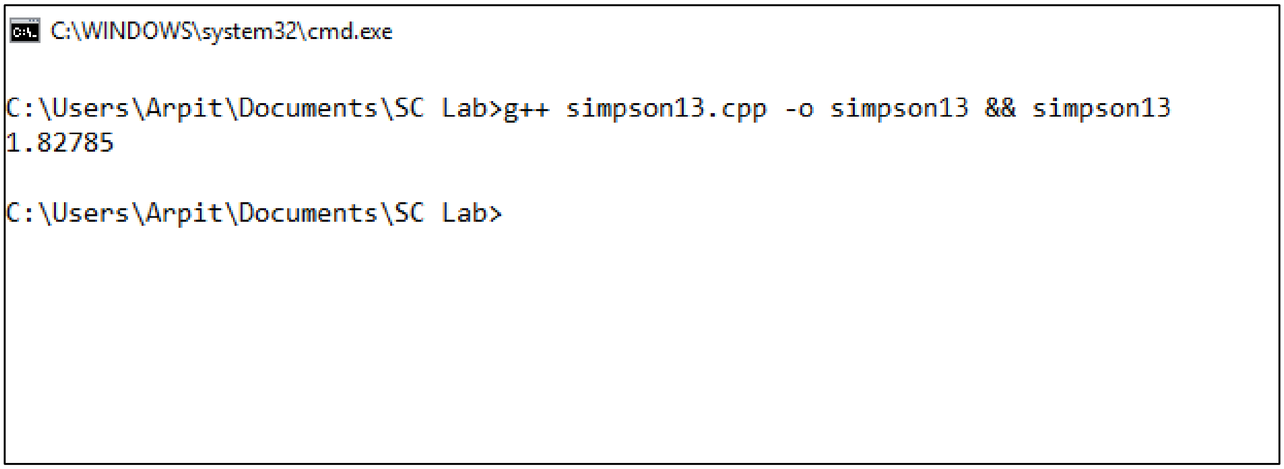
Experiment 9

AIM: Evaluate the integral using Simpson’s 1/3rd Formula

$$\int_{4}^{5.2} \boldsymbol{log(x)}$$

```
#include <iostream>

#include <cmath>

using namespace std;

double h = 0.2, lower = 4, upper = 5.2;

double f(double x) {

    return log(x);

}

int main() {

    double x = lower + h, sum = 0;

    int counter = 1;

    while(x < upper) {

        if(counter % 2 == 0)

            sum += (2 * f(x));

        else

            sum += (4 * f(x));

        counter++;

        x += h;

    }

    sum += (f(lower) + f(upper));

    sum *= (h / 3);

    cout << sum << “\n”;

}
```

ANSWER : 1.82785



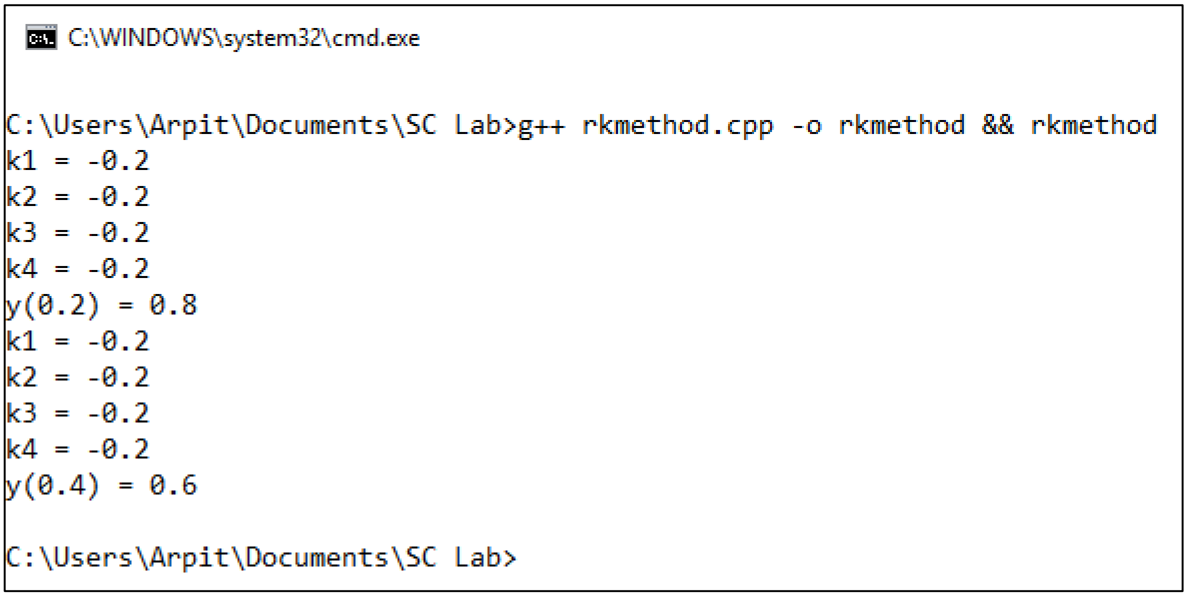
```
C:\Users\Arpit\Documents\SC Lab>g++ simpson13.cpp -o simpson13 && simpson13
1.82785

C:\Users\Arpit\Documents\SC Lab>
```

Experiment 10

AIM: To solve the given ODE using Runge Kutta Method and find $y(0.2)$ and $y(0.4)$.

$$\frac{dy}{dx} = \frac{y^2 - x^2}{x^2 - y^2}$$

```
#include <iostream>
#include <cmath>
using namespace std;
double f(double y, double x) {
      return ((pow(y, 2) - pow(x, 2)) / (pow(x, 2) - pow(y, 2)));
}
int main() {
      double y0 = 1, x0 = 0, y1, n = 0.4, h = 0.2, fx, k1, k2, k3, k4;
      for(; x0 < n ; x0 += h) {
            fx = f(x0, y0);
            k1 = h * fx;
            fx = f(x0 + h / 2, y0 + k1 / 2);
            k2 = h * fx;
            fx = f(x0 + h / 2, y0 + k2 / 2);
            k3 = h * fx;
            fx = f(x0 + h / 2, y0 + k2 / 2);
        k4 = h * fx;
        y1 = y0 + ( k1 + 2 * k2 + 2 * k3 + k4) / 6;
        cout << "k1 = " << k1 << "\n";
      cout << "k2 = " << k2 << "\n";
        cout << "k3 = " << k3 << "\n";
        cout << "k4 = " << k4 << "\n";
        cout << "y(" << (x0 + h) << ") = " << y1 << "\n";
            y0 = y1;
      }
}
ANSWER: y(0.2) = 0.8, y(0.4) = 0.6
```



```
C:\Users\Arpit\Documents\SC Lab>g++ rkmethod.cpp -o rkmethod && rkmethod
k1 = -0.2
k2 = -0.2
k3 = -0.2
k4 = -0.2
y(0.2) = 0.8
k1 = -0.2
k2 = -0.2
k3 = -0.2
k4 = -0.2
y(0.4) = 0.6

C:\Users\Arpit\Documents\SC Lab>
```