**Heaven’s Light is Our Guide**

# Rajshahi University of Engineering and Technology

## Department of Computer Science and Engineering

**Course No:** CSE.2104

**Course Title:** Sessional based on CSE.2104 ( Numerical Methods )

**Lab Report On:** Newton’s Forward & Backward Interpolation Formula

**Submitted To**

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# CHAPTER 1

**Title 1:** Implementation of Numerical Integration to Find Volume (Ex. 6.9 S.S. Sastry).

## 1.1 Objective

- Gathering knowledge about Numerical Integration to Find Volume.
- Implementing the Knowledge in C++.

## 1.2 Methodology

- Load coordinates from .txt file.
- Find n, the number of coordinates.
- Calculate volume by one of Numerical Integration Formula-
  - Generate $x \sim y^2$ table from coordinates.
  - Find the value of h.
  - Calculate integrated value.
  - Calculate Volume by multiplying integrated value with Pi.

## 1.3 Implementation

I have implemented one of Numerical Integration Formula (Simpson's 1/3 Rule) to find the Volume according to the above Pseudocode. I have taken the coordinates from a text file. The tools I used here are :

- C++
- Text File
- Editor: CodeBlocks

### 1.3.1 Code

```
//This code is the Implementation of the Example 6.9 ( S.S. Sastry )

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

int n;
double x[101],y[101];
string buf;
vector<string>temp;
#define pi 3.1416

void input(){
   ifstream f1;
   f1.open("6.9_p.txt");

   while(! f1.eof()){
      f1>>buf;
      temp.push_back(buf);
      buf.clear();
   }

   for(int i=0,j=0;i<temp.size();i+=2,j++){
      x[j]=stod(temp.at(i));
      y[j]=stod(temp.at(i+1));
      n=j+1;
   }
}

void show(){
   for(int i=0;i<n;i++){
      cout<<"\t"<<x[i]<<"\t\t"<<y[i]<<endl;
   }
}

void double_y(){
   for(int i=0;i<n;i++){
      y[i]*=y[i];
   }
}
```

```
double simpson(){
   double h,res,val=0;

   h=x[1]-x[0];
   res=y[0]+y[n-1];

   for(int i=1;i<n-1;i++){
      if(i%2){
         res+=(4.0*y[i]);
      }
      else{
         res+=(2.0*y[i]);
      }
   }

   val=(h*res)/3.0;

   return val;
}

void volume(){
   input();
   cout<<"\n\t X\t\tY\n\t..................."<<endl;
   show();
   double_y();
   cout<<"\n\t X\t\tY*Y\n\t..................."<<endl;
   show();

   cout<<"\n\tThe Volume is: "<<pi*simpson()<<endl;
}


int main(){

   volume();

   return 0;
}
```

## 1.4 Output

I had used the following dataset in the implementation:

| X | 0.00 | 0.25 | 0.50 | 0.75 | 1.00 |
|---|---|---|---|---|---|
| Y | 1.0000 | 0.9896 | 0.9589 | 0.9089 | 0.8415 |

And my output was like below:

```
"F:\3rd Semester\CSE\CSE.2104\17-11-2020\1803046.exe"

         X              Y
        --------------------
        0               1
        0.25            0.9896
        0.5             0.9589
        0.75            0.9089
        1               0.8415

         X              Y*Y
        --------------------
        0               1
        0.25            0.979308
        0.5             0.919489
        0.75            0.826099
        1               0.708122

        The Volume is: 2.81925

Process returned 0 (0x0)   execution time : 1.234 s
Press any key to continue.
```

**Title 2:** Implementation of Numerical Integration (Ex. 6.10 S.S. Sastry).

## 2.1 Objective

- Gathering knowledge about Numerical Integration.
- Implementing the Knowledge in C++.

## 2.2 Methodology

- Select the value of h.
- Generate x ~ y table from x=0 to 1.
- Calculate Integrated value by Numerical Integration Formula-
  - At first follow Trapezoidal Rule.
  - Then follow Simspon’s 1/3 Rule.

## 2.3 Implementation

I have implemented both Trapezoidal Rule and Simpson’s 1/3 Rule to find the Integrated Value according to the above Pseudocode. I have generated the x ~ y table for each value of h. The tools I used here are :

- C++
- Editor: CodeBlocks

## 2.3.1 Code

```
//This code is the Implementation of the Example 6.10 ( S.S. Sastry )

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

double x[51],y[51];
int n;

void show_xy(){
   cout<<"\n\t X\t  Y\n\t.............."<<endl;
   for(int i=0;i<n;i++){
      cout<<"\t"<<x[i]<<"\t "<<y[i]<<endl;
   }
}

void Trapezoidal(double h){
   double res=y[0]+y[n-1];

   for(int i=1;i<n-1;i++){
      res+=(2*y[i]);
   }
   res=(h*res)/2;

   cout<<"\n\tThe Trapezoidal Integrated Value: "<<res<<endl;
}

void Simpsons(double h){
   double res=y[0]+y[n-1];

   for(int i=1;i<n-1;i++){
      if(i%2){
         res+=(4*y[i]);
      }
      else{
         res+=(2*y[i]);
      }
   }
   res=(h*res)/3;
   cout<<"\n\tThe Simpson's 1/3 Integrated Value: "<<res<<endl;

}

void Init(double h){
```

```
    n=(1.0/h)+1;

    x[0]=0.0;
    for(int i=0;i<n;i++){
        x[i]=x[0]+(i*h);
        y[i]=1/(1+x[i]);
    }
    show_xy();
    Trapezoidal(h);
    Simpsons(h);
}

void menu(){
    cout<<"\n\t  Menu of H\n\t............"<<endl;
    cout<<"\t1. 0.5\n\t2. 0.25\n\t3. 0.125\n\t0. Exit\n"<<endl;
    cout<<"\tEnter your Choice: ";
}
int main(){
    int b=1;
    while(b){
        int a;
        menu();
        cin>>a;
        switch(a){
            case 1: Init(0.5); break;
            case 2: Init(0.25); break;
            case 3: Init(0.125); break;
            case 0: b=0; break;

            default: cout<<"Invalid Input\n"<<endl;break;
        }
    }


    return 0;
}
```

## 2.4 Output

The equation of the problem was **Y = 1 / ( 1 + X )**

And my output was like below:

```
"F:\3rd Semester\CSE\CSE.2104\17-11-2020\1803046_6.10.exe"
          Menu of H
        .............
        1. 0.5
        2. 0.25
        3. 0.125
        0. Exit

        Enter your Choice: 1

         X        Y
        ...............
        0        1
        0.5      0.666667
        1        0.5

        The Trapezoidal Integrated Value: 0.708333

        The Simpson's 1/3 Integrated Value: 0.694444

          Menu of H
        .............
        1. 0.5
        2. 0.25
        3. 0.125
        0. Exit

        Enter your Choice: 2

         X        Y
        ...............
        0        1
        0.25     0.8
        0.5      0.666667
        0.75     0.571429
        1        0.5

        The Trapezoidal Integrated Value: 0.697024

        The Simpson's 1/3 Integrated Value: 0.693254

          Menu of H
        .............
        1. 0.5
        2. 0.25
        3. 0.125
        0. Exit

        Enter your Choice: 0

Process returned 0 (0x0)   execution time : 17.522 s
```

# End #