**2. Topic – Approximation of Definite Integral using C program**

* **Problem Statement**

Write a program that finds an approximate value of a definite integral.Let l be the left and r the right boundary for the integral. Also let h be the step size. The idea is to break the interval [l, r] into sub-intervals [l, l + h], [l + h, l + 2h], [l + 2h, l + 3h], ..., [r − h, r]. Assume that r − l is an integral multiple of h. Your program evaluates the function to be integrated at the center of each interval, multiplies these values by the width h and computes the sum .

**Input example:** /\* Here user will give the value of h, very close to zero like 0.0003,0.00001 etc. and then the value of l and r i.e the left and right bounadries. \*/

Enter a very small value of h which tends to zero

0.0004

Enter the left boundary

3.1

Enter the right boundary

4.5

**Output example:**

The approximate value of the definite integral of the function 8x^3+12x^2+x+1 in the limit 3.100000 to 4.500000 is: 887.085846

* **Proposed C Code**

**/\* ---------- definiteintegral.c--------------- \*/**

#include<stdio.h>

int main()

{

double h;

/\* Here h should be very close to zero like 0.0001,0.00003 etc.\*/

printf("Enter a very small value of h which tends to zero\n");

scanf("%lf",&h);

double l,r;

printf("Enter the left boundary\n");

scanf("%lf",&l);

printf("Enter the right boundary\n");

scanf("%lf",&r);

double a1 = l;

/\*The a1 variable will be the lower bounds in every intervals starting from the extreme lower bound \*/

double a2 = l+h;

/\*The a2 variable will be the upper bounds in every intervals starting from the extreme lower bound \*/

long int interval =((r-l)/h);

/\* The number of interval is an integral multiple of h \*/

double integral\_sum = 0;

/\* integral\_sum variable is taken to store the successive results after each iteration and finally it will give the value of the approximate result afetr final iteration \*/

for ( long int i = 1 ; i <= interval ; i++ )

{

double x = (a1 + a2)/2;

/\* x is the variable whose function is to be integrated and it is taken as the averge of the lower and upper bounds in every interval \*/

double function = 8\*x\*x\*x + 12\*x\*x + x + 1;

/\* A function of x is assumed as f(x) = 8x^3+12x^2+x+1 \*/

integral\_sum += h\*function;

a1 += h;

a2 += h;

/\* In each iteration a1 and a2 will store the lower and upper bounds of the next interval \*/

}

printf("The approximate value of the definite integral of the function 8x^3+12x^2+x+1 in the limit %lf to %lf is: %lf",l,r,integral\_sum);

return 0;

}

**/\*------------------------------------------------------------------------------------------------------------------------- \*/**

* **Conclusion**

**The proposed algorithm has a runtime of O(n) where n is generally the number of iterations under consideration.**

* **Limitations : As the definite integral of any function using these limit of sum method gives the approximate value of the actual integration so it depends on the value of h i.e smaller h yields better result.**
* **Assumptions: Here we are considering the function f(x) = 8x^3+12x^2+x+1 and requesting user to give the value of h such that h tends to 0 (like 0.002,0.0004 etc) ,so all our calculations are based on these assumptions.**