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#include <stdio.h>
#include <stdlib.h>
#include <math.h>

//The main function
double f(double x){
    return (double)( 1.0+tanh(x) );
}

//The actual derivative function
double fd(double x){
    return (double)( pow((1/cosh(x)),2) );
}

//The first derivative using 2 points
double fd2(double x , double h){
    return (double)( (f(x+h)-f(x))/h );
}

//The first derivative using 3 points
double fd3(double x , double h){
    return (double)( (f(x+h)-f(x-h))/(2*h) );
}

//The first derivative using 5 points
double fd5(double x , double h){
    return (double)( (f(x-2*h)-8*f(x-h)+8*f(x+h)-f(x+2*h))/(12*h) );
}

int main()
{
    double a=-4 , b=4; //The interval borders
    double h[3]={0.1 , 0.01 , 0.001};

    //Open files to save data
    FILE *output[10];
    //1 for h1=0.1 -- 2 for h2=0.01 -- 3 for h3=0.001
    output[0]= fopen("2points-1.txt", "w");
    output[1]= fopen("2points-2.txt", "w");
    output[2]= fopen("2points-3.txt", "w");

    output[3]= fopen("3points-1.txt", "w");
    output[4]= fopen("3points-2.txt", "w");
    output[5]= fopen("3points-3.txt", "w");

    output[6]= fopen("5points-1.txt", "w");
    output[7]= fopen("5points-2.txt", "w");
    output[8]= fopen("5points-3.txt", "w");

    output[9]= fopen("ActualDerivative.txt", "w");

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//Getting all the set points using the derivatives methods
int c=0;//is used for printing in the right text file
for(int i=0;i<3;i++){//For the the three types: 2,3,5 points
    for(int j=0;j<3;j++){//For change h for each type
        for(double x=a;x<=b;x+=h[j]){//For calculating all the set points in the interval
            if(i==0) fprintf(output[c], "%e\t%e\n" , x ,fd2(x,h[j]));
            else if(i==1) fprintf(output[c], "%e\t%e\n" , x ,fd3(x,h[j]));
            else if(i==2) fprintf(output[c], "%e\t%e\n" , x ,fd5(x,h[j]));
        }
        c++;
    }
}

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//Getting all the actual set points
for(double x=a;x<=b;x+=h[2]){
    fprintf(output[9], "%e\t%e\n" , x , fd(x) );
}

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printf("Done :) \n");

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return 0;

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}

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