Mehak Gupta
301311972

Computing Assignment 7

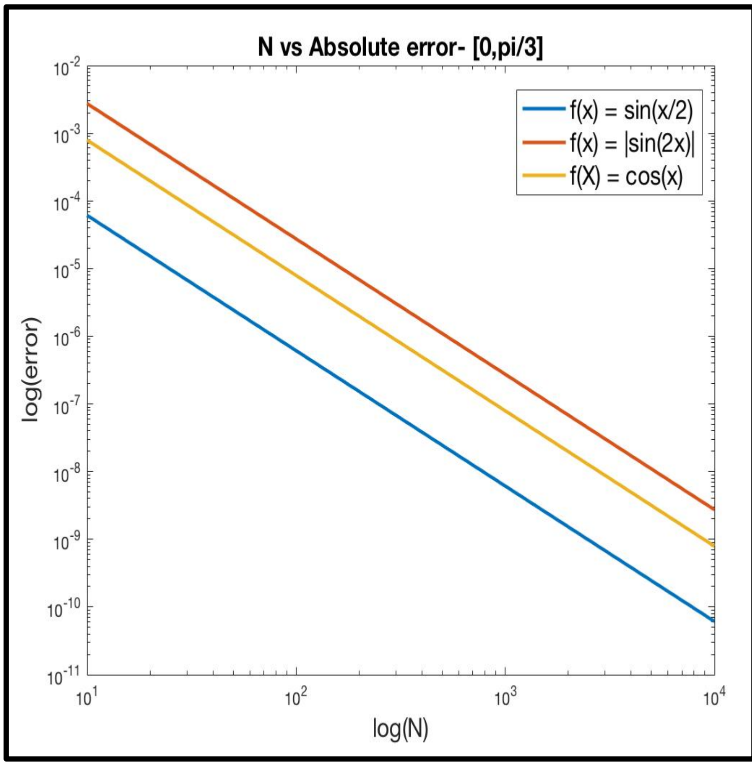

Fig 1.

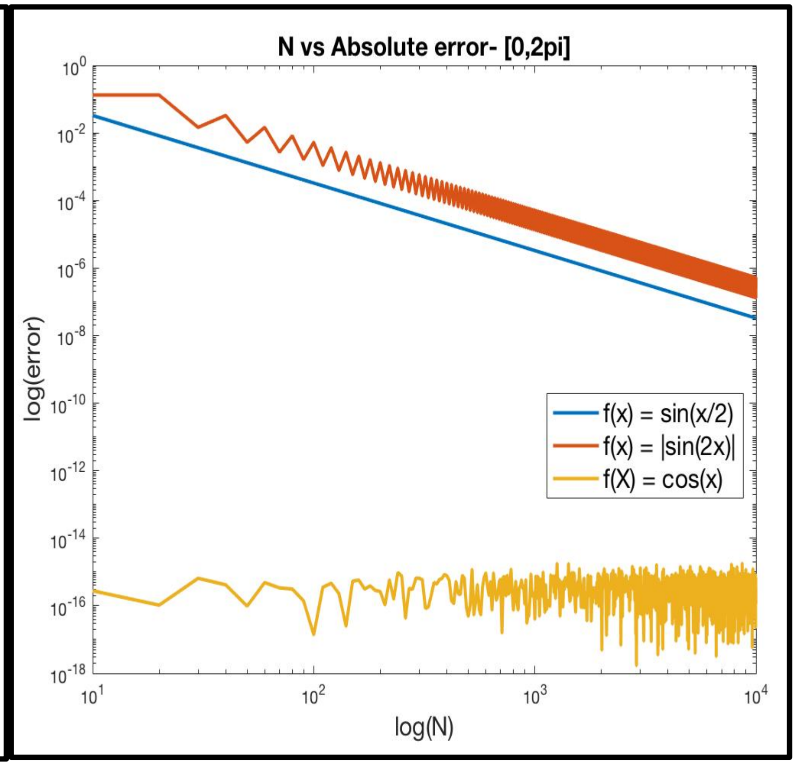

Fig 2.

a). The value of the integral of function x^3 on [0,1] interval with N =100 using the trapezoidal rule is 0.250025000000000.

b). The loglog plot of the respective functions on the interval : [0, pi/3] is shown in the Fig 1 and the loglog plot of the same functions on the interval :[0, 2pi] is shown in Fig 2. The N taken for the two plots is 10000. In fig 1 with negative slopes the functions are almost linear. In fig 2 the first two functions have negative slopes while the function Cos(x) shows a different behavior with low error values. Its due to the nature of the cos curve that we add positive and negative areas on I2 Interval ending up with high accuracy. It's basically cancellation of the errors in the small areas of trapezoid.

c). Rate of convergence:

- Interval [2,pi/3]
  sin(x/2) = -2.00000270733650
  |sin(2x)| = -2.000043452775165
  cos(x) = -2.000010859744169

- Interval [0,2pi]
  sin(x/2) = -2.000097832787546
  |sin(2x)| = -1.980048552818373
  cos(x) = -0.0253228266141930

The function always seems to converge at the same rate but we can observe the zig zag lines on the plot which changes the calculated value of convergence as compared to the actual convergence. This result means the calculated convergence is not equal to epsilon but trapezoidal rule theoretically converges to machine epsilon as N increases.

CODE

```
a1 =0;
a2 =pi/3;

b1 = 0;
b2 = 2*pi;

f1 =@(x)sin(x/2);
f2 =@(x)abs(sin(2*x));
f3 =@(x) cos(x);
NInterval= 10:10:10000;
myLength= length(NInterval);

f1_a = zeros(myLength,1);
f2_a = zeros(myLength,1);
f3_a = zeros(myLength,1);
f1_b = zeros(myLength,1);
f2_b = zeros(myLength,1);
f3_b = zeros(myLength,1);

for n = NInterval
    f1_a(n/10) = trapezoidrule(f1,a1,a2,n);
    f1_b(n/10) = trapezoidrule(f1,b1,b2,n);
    f2_a(n/10) = trapezoidrule(f2,a1,a2,n);
    f2_b(n/10) = trapezoidrule(f2,b1,b2,n);
    f3_a(n/10) = trapezoidrule(f3,a1,a2,n);
    f3_b(n/10) = trapezoidrule(f3,b1,b2,n);
end

true_f1_a = integral(f1, a1,a2);
true_f2_a = integral(f2, a1,a2);
true_f3_a = integral(f3, a1,a2);

true_f1_b = 4;
true_f2_b = 4;
true_f3_b = 0;

abs_f1_a = zeros(myLength,1);
abs_f2_a = zeros(myLength,1);
abs_f3_a = zeros(myLength,1);

abs_f1_b = zeros(myLength,1);
abs_f2_b = zeros(myLength,1);
abs_f3_b = zeros(myLength,1);

for l=1:myLength
   abs_f1_a(l) = abs(true_f1_a - f1_a(l));
   abs_f2_a(l) = abs(true_f2_a - f2_a(l));
   abs_f3_a(l) = abs(true_f3_a - f3_a(l));
end
for g=1:myLength
   abs_f1_b(g) = abs(true_f1_b - f1_b(g));
   abs_f2_b(g) = abs(true_f2_b - f2_b(g));
   abs_f3_b(g) = abs(true_f3_b - f3_b(g));
end

figure(1)
line1 = loglog(NInterval, abs_f1_a)
hold on;
```

```
line2 = loglog(NInterval, abs_f2_a)
line3 = loglog(NInterval, abs_f3_a)
title({'N vs Absolute error- [0,pi/3]'}, 'fontsize', 15);
ylabel('log(error)', 'fontsize', 15);
xlabel('log(N)', 'fontsize',15);
leg= legend('f(x) = sin(x/2)', 'f(x) = |sin(2x)|', 'f(X) = cos(x)');
set(leg, 'location','best','fontsize', 15);
set(line1, 'LineWidth', 2);
set(line2, 'LineWidth', 2);
set(line3, 'LineWidth', 2);


figure(2)
line4 = loglog(NInterval, abs_f1_b)
hold on;
line5 = loglog(NInterval, abs_f2_b)
line6 = loglog(NInterval, abs_f3_b)
title({'N vs Absolute error- [0,2pi]'}, 'fontsize', 15);
ylabel('log(error)', 'fontsize', 15);
xlabel('log(N)', 'fontsize',15);
leg= legend('f(x) = sin(x/2)', 'f(x) = |sin(2x)|', 'f(X) = cos(x)');
set(leg, 'location','best','fontsize', 15);
set(line4, 'LineWidth', 2);
set(line5, 'LineWidth', 2);
set(line6, 'LineWidth', 2);
```