Table of Contents

Numerical Integration for GTE

```matlab
function fval = numericalIntegration(f, a, b, n, choice)
    switch choice
        case 1
            fval = trap(f, a, b, n);
        case 2
            fval = oneThird(f, a, b, n);
        case 3
            fval = threeEighth(f, a, b, n);
    end
end
```

```
Not enough input arguments.

Error in numericalIntegration (line 3)
    switch choice
```

Trapezoidal Rule

```matlab
function fval = trap(f, a, b, n)
    h = (b - a)./n;
    fval = 0;
    for i = 1:n
        fval = fval + h.*(f(a + (i - 1).*h) + f(a + i.*h))./2;
    end
end
```

Simpson's One Third Rule

```matlab
function fval = oneThird(f, a, b, n)
    h = (b - a)./(2.*n);
    fval = 0;
    for i = 1:2:2*n
        fval = fval + h.*(f(a + (i - 1).*h) + 4.*f(a + i.*h) + f(a +
 (i + 1).*h))./3;
    end
end
```

Simpson's Three Eighth Rule

```matlab
function fval = threeEighth(f, a, b, n)
```

```
    h = (b - a)./(3.*n);
    fval = 0;
    for i = 1:3:3*n
        fval = fval + 3.*h.*(f(a + (i - 1).*h) + 3.*f(a + i.*h) +
 3.*f(a + (i + 1).*h) + f(a + (i + 2).*h))./8;
    end
end
```

Published with MATLAB® R2020b

Table of Contents

Numerical Integration for LTE

```matlab
function fval = numericalIntegrationSingle(f, a, b, choice)
    switch choice
        case 1
            fval = trap(f, a, b);
        case 2
            fval = oneThird(f, a, b);
        case 3
            fval = threeEighth(f, a, b);
    end
end
```

Not enough input arguments.

Error in numericalIntegrationSingle (line 3)
*   switch choice*

Trapezoidal Rule

```matlab
function fval = trap(f, a, b)
    h = b - a;
    fval = h.*(f(a) + f(a + h))./2;
end
```

Simpson's One Third Rule

```matlab
function fval = oneThird(f, a, b)
    h = (b - a)./2;
    fval = h.*(f(a) + 4.*f(a + h) + f(a + 2.*h))./3;
end
```

Simpson's Three Eighth Rule

```matlab
function fval = threeEighth(f, a, b)
    h = (b - a)./3;
    fval = 3.*h.*(f(a) + 3.*f(a + h) + 3.*f(a + 2.*h) + f(a +
 3.*h))./8;
end
```

Published with MATLAB® R2020b

Q1 - GTE

Table of Contents

Numerical integration of 2 - x + ln(x)

a = 1 and b = 2

```
clc;
clear;
close all;
```

True Value of the integration of the function from b to a

```
a = 1;
b = 2;
n = 100;
truVal = integratedf(b) - integratedf(a);
```

Calculating the error using Trapezoid Rule

```
trap = numericalIntegration(@f, a, b, n, 1);
errTrap = abs(trap - truVal);
```

Calculating the error using Simpson's One Third Rule

```
oneThird = numericalIntegration(@f, a, b, n, 2);
errOneThird = abs(oneThird - truVal);
```

Calculating the error using Simpson's Three Eighth Rule

```
threeEighth = numericalIntegration(@f, a, b, n, 3);
errThreeEighth = abs(threeEighth - truVal);
```

Displaying the errors

```
disp(['The error using Trapezoidal Rule is : ', num2str(errTrap)]);
disp(['The error using Simpson''s One Third Rule is : ',
 num2str(errOneThird)])
disp(['The error using Simpson''s Three Eighth Rule is : ',
 num2str(errThreeEighth)])

The error using Trapezoidal Rule is : 4.1666e-06
The error using Simpson's One Third Rule is : 6.0758e-12
The error using Simpson's Three Eighth Rule is : 2.7008e-12
```
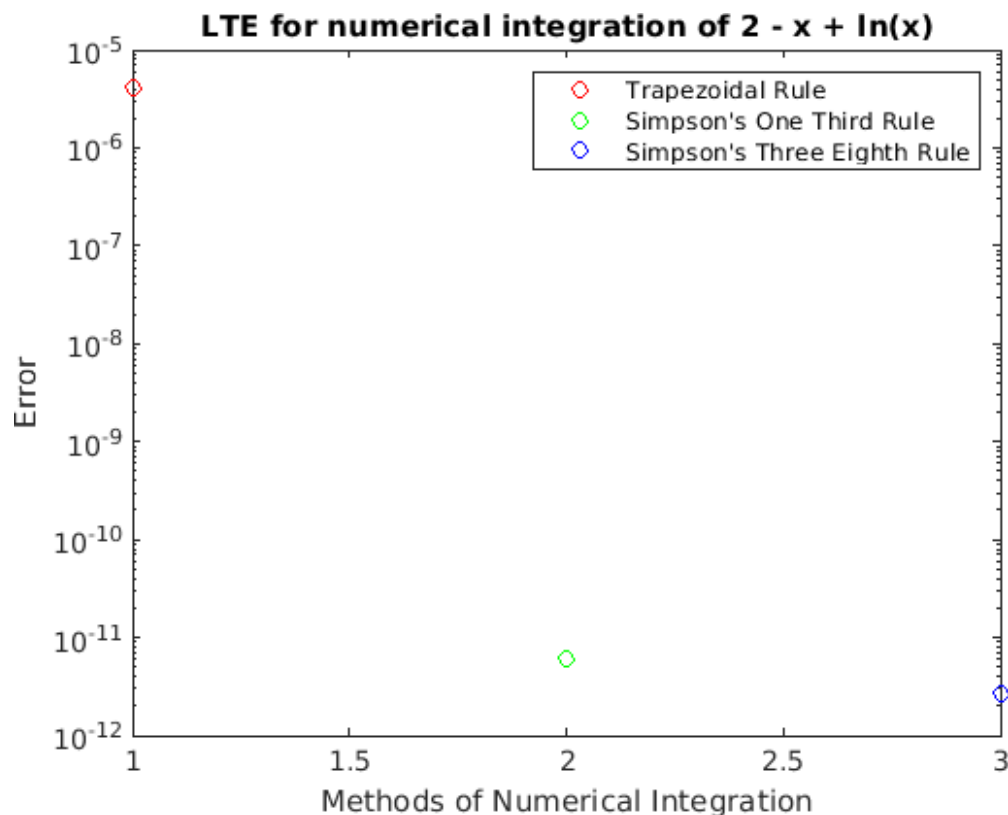
Plots

```
semilogy(1, errTrap,'ro', 2, errOneThird, 'go', 3,
 errThreeEighth, 'bo')
legend('Trapezoidal Rule', 'Simpson''s One Third Rule', 'Simpson''s
 Three Eighth Rule')
title('LTE for numerical integration of 2 - x + ln(x)')
xlabel('Methods of Numerical Integration')
ylabel('Error')
```


Function that is to be integrated

```
function fval = f(x)
```

```matlab
        fval = 2 - x + log(x);
    end
```

Integrated Function

```matlab
    function fx = integratedf(x)
        fx = 2.*x - (x.^2)./2 + x.*log(x) - x;
    end
```

Published with MATLAB® R2020b

Q1 - LTE

Table of Contents

Numerical integration of 2 - x + ln(x)

a = 1 and b = 2

```
clc;
clear;
close all;
```

True Value of the integration of the function from b to a

```
a = 1;
b = 2;
truVal = integratedf(b) - integratedf(a);
```

Calculating the error using Trapezoid Rule

```
trap = numericalIntegrationSingle(@f, a, b, 1);
errTrap = abs(trap - truVal);
```

Calculating the error using Simpson's One Third Rule

```
oneThird = numericalIntegrationSingle(@f, a, b, 2);
errOneThird = abs(oneThird - truVal);
```

Calculating the error using Simpson's Three Eighth Rule

```
threeEighth = numericalIntegrationSingle(@f, a, b, 3);
```

```
errThreeEighth = abs(threeEighth - truVal);
```

Displaying the errors

```
disp(['The error using Trapezoidal Rule is : ', num2str(errTrap)]);
disp(['The error using Simpson''s One Third Rule is : ',
 num2str(errOneThird)])
disp(['The error using Simpson''s Three Eighth Rule is : ',
 num2str(errThreeEighth)])

The error using Trapezoidal Rule is : 0.039721
The error using Simpson's One Third Rule is : 0.00045976
The error using Simpson's Three Eighth Rule is : 0.00021058
```
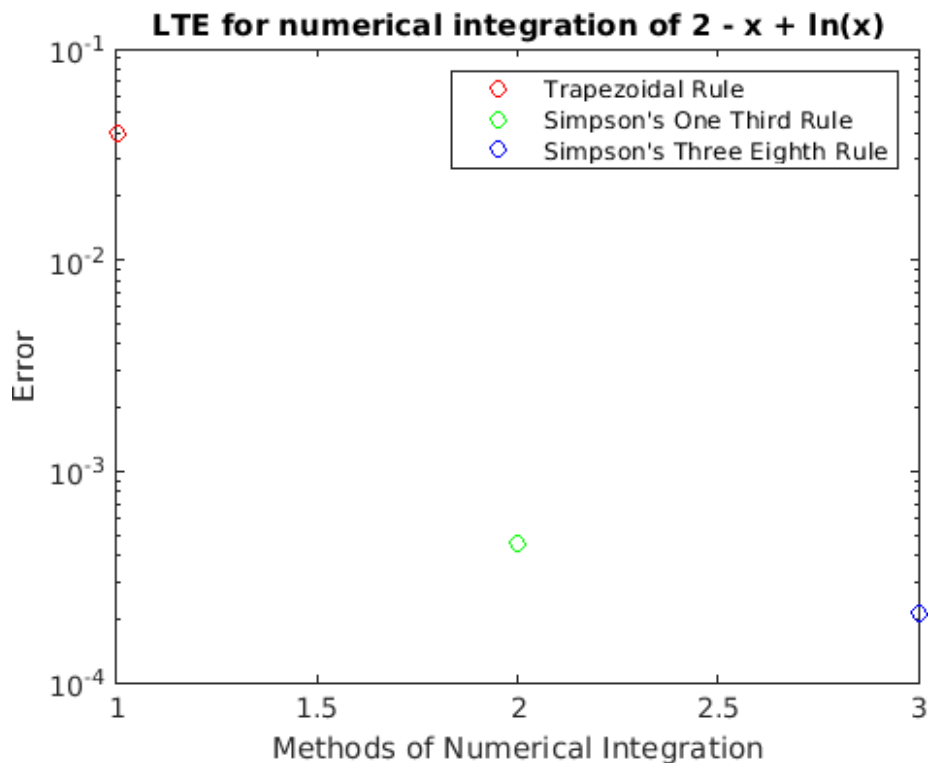
Plots

```
semilogy(1, errTrap,'ro', 2, errOneThird, 'go', 3,
 errThreeEighth, 'bo')
legend('Trapezoidal Rule', 'Simpson''s One Third Rule', 'Simpson''s
 Three Eighth Rule')
title('LTE for numerical integration of 2 - x + ln(x)')
xlabel('Methods of Numerical Integration')
ylabel('Error')
```


Function that is to be integrated

```
function fval = f(x)
```

```
        fval = 2 - x + log(x);
    end
```

Integrated Function

```
function fx = integratedf(x)
    fx = 2.*x - (x.^2)./2 + x.*log(x) - x;
end
```

Published with MATLAB® R2020b

Q2 - GTE

Table of Contents

Numerical integration of x^3 - 2x,

a = 0 and b = pi/2

```
clc;
clear;
close all;
```

True Value of the integration of the function from b to a

```
a = 0;
b = pi./2;
n = 100;
truVal = integratedf(b) - integratedf(a);
```

Calculating the error using Trapezoid Rule

```
trap = numericalIntegration(@f, a, b, n, 1);
errTrap = abs(trap - truVal);
```

Calculating the error using Simpson's One Third Rule

```
oneThird = numericalIntegration(@f, a, b, n, 2);
errOneThird = abs(oneThird - truVal);
```

Calculating the error using Simpson's Three Eighth Rule

```
threeEighth = numericalIntegration(@f, a, b, n, 3);
```

```
errThreeEighth = abs(threeEighth - truVal);
```

Displaying the errors

```
disp(['The error using Trapezoidal Rule is : ', num2str(errTrap)]);
disp(['The error using Simpson''s One Third Rule is : ',
 num2str(errOneThird)])
disp(['The error using Simpson''s Three Eighth Rule is : ',
 num2str(errThreeEighth)])

The error using Trapezoidal Rule is : 0.0001522
The error using Simpson's One Third Rule is : 1.1102e-16
The error using Simpson's Three Eighth Rule is : 1.1102e-16
```
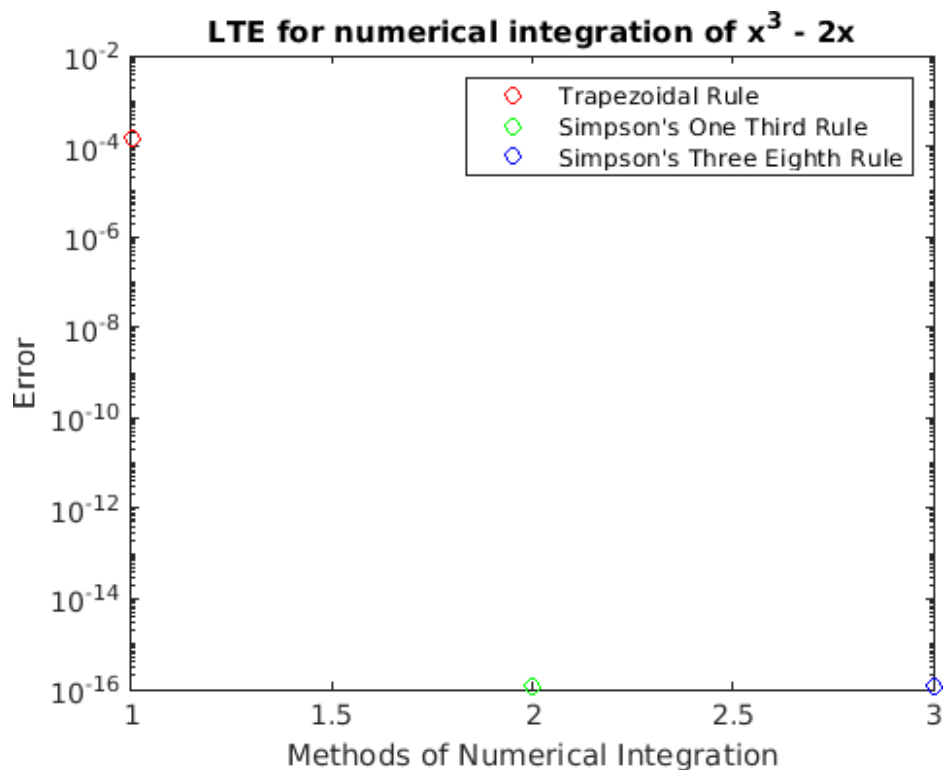
Plots

```
semilogy(1, errTrap,'ro', 2, errOneThird, 'go', 3,
 errThreeEighth, 'bo')
legend('Trapezoidal Rule', 'Simpson''s One Third Rule', 'Simpson''s
 Three Eighth Rule')
title('LTE for numerical integration of x^3 - 2x')
xlabel('Methods of Numerical Integration')
ylabel('Error')
```


Function that is to be integrated

```
function fval = f(x)
```

```matlab
    fval = x.^3 - 2.*x;
end
```

Integrated Function

```matlab
function fx = integratedf(x)
    fx = (x.^4)./4 - x.^2;
end
```

Published with MATLAB® R2020b

Q2 - LTE

Table of Contents

Numerical integration of x^3 - 2x,

a = 0 and b = pi/2

```
clc;
clear;
close all;
```

True Value of the integration of the function from b to a

```
a = 0;
b = pi./2;
truVal = integratedf(b) - integratedf(a);
```

Calculating the error using Trapezoid Rule

```
trap = numericalIntegrationSingle(@f, a, b, 1);
errTrap = abs(trap - truVal);
```

Calculating the error using Simpson's One Third Rule

```
oneThird = numericalIntegrationSingle(@f, a, b, 2);
errOneThird = abs(oneThird - truVal);
```

Calculating the error using Simpson's Three Eighth Rule

```
threeEighth = numericalIntegrationSingle(@f, a, b, 3);
```

```
errThreeEighth = abs(threeEighth - truVal);
```

Displaying the errors

```
disp(['The error using Trapezoidal Rule is : ', num2str(errTrap)]);
disp(['The error using Simpson''s One Third Rule is : ',
 num2str(errOneThird)])
disp(['The error using Simpson''s Three Eighth Rule is : ',
 num2str(errThreeEighth)])

The error using Trapezoidal Rule is : 1.522
The error using Simpson's One Third Rule is : 1.1102e-16
The error using Simpson's Three Eighth Rule is : 0
```

Plots

```
semilogy(1, errTrap,'ro', 2, errOneThird, 'go', 3,
 errThreeEighth, 'bo')
legend('Trapezoidal Rule', 'Simpson''s One Third Rule', 'Simpson''s
 Three Eighth Rule')
title('LTE for numerical integration of x^3 - 2x')
xlabel('Methods of Numerical Integration')
ylabel('Error')
```
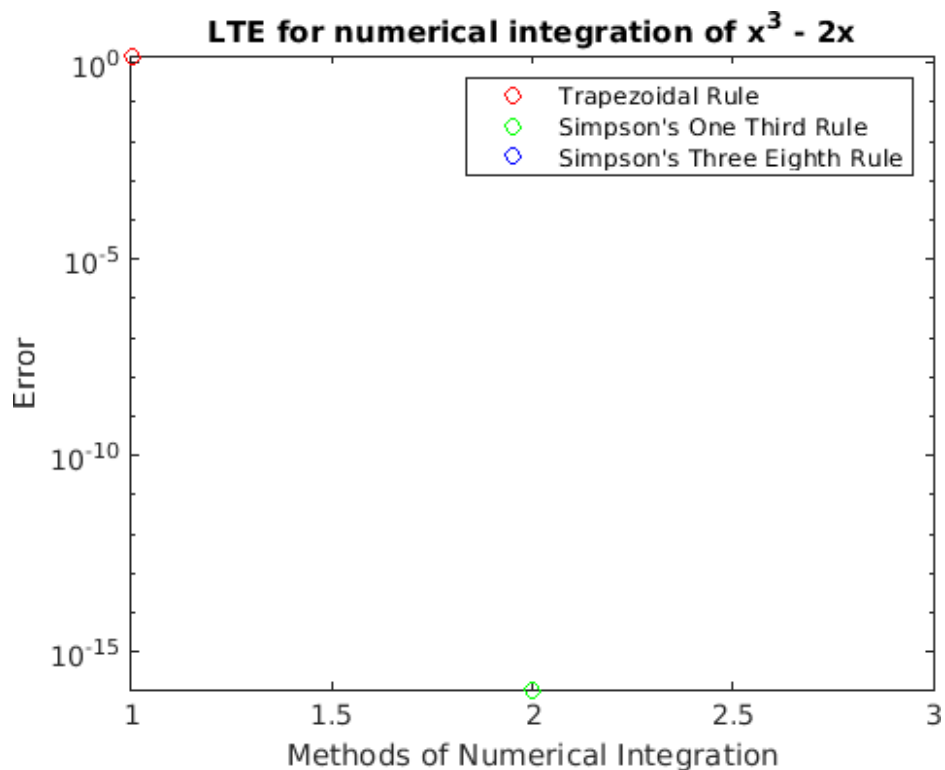

Function that is to be integrated

```
function fval = f(x)
```

```
        fval = x.^3 - 2.*x;
end
```

Integrated Function

```
function fx = integratedf(x)
    fx = (x.^4)./4 - x.^2;
end
```

Published with MATLAB® R2020b