Trapezoidal Rule

- Question 1:Solve $\int_0^1 \frac{1}{1+x} \, dx$, using Trapezoidal rule

In[9]:=
```
f[x_] := 1 / (1 + x)
a = 0.0;
b = 1.0;
h = b - a;
AprxInt = (h / 2) * (f[a] + f[b])
ExactInt = Integrate[f[x], {x, 0.0, 1.0}]
Abserr1 = Abs[ExactInt - AprxInt]
```

Out[13]= 0.75

Out[14]= 0.693147

Out[15]= 0.0568528

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- **Question 2:Solve $\int_0^2 \frac{1}{3x-9} \, dx$, using Trapezoidal rule .**

In[30]:=
```
f[x_]:=1/(3x-9)
a=0.0;
b=2.0;
h=b-a;
AprxInt=(h/2)*(f[a]+f[b])
ExactInt=Integrate[f[x],{x,0.0,2.0}]
Abserr1=Abs[ExactInt-AprxInt]
```

Out[34]= -0.444444

Out[35]= -0.366204

Out[36]= 0.0782403

- Question 3: Solve $\int_0^1 \frac{1}{1+x} \, dx$, using composite Trapezoidal rule by 8 step-size length

```
In[1]:= f[x_] := 1 / (1 + x)
a = 0.0;
b = 1.0;
n = 10;
h = (b - a) / n;
```

$$AprxIntCom = (h / 2) * \left(f[a] + 2 * \left(\sum_{i=1}^{n-1} f[a + i * h]\right) + f[b]\right)$$

```
ExactInt = Integrate[f[x], {x, 0.0, 1.0}]
Abserr1 = Abs[ExactInt - AprxIntCom]

Out[6]= 0.693771

Out[7]= 0.693147

Out[8]= 0.000624223
```

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- Question 4 : Solve $\int_0^1 \frac{1}{5 x^2 + 2} \, dx$, using composite Trapezoidal rule by 4 step - size length.

```
In[45]:= f[x_] := 1 / (5 x ^ 2 + 2)
a = 0.0;
b = 1.0;
n = 4;
h = (b - a) / n;
```

$$AprxIntCom = (h / 2) * \left(f[a] + 2 * \left(\sum_{i=1}^{n-1} f[a + i * h]\right) + f[b]\right)$$

```
ExactInt = Integrate[f[x], {x, 0.0, 1.0}]
Abserr1 = Abs[ExactInt - AprxIntCom]

Out[50]= 0.317336

Out[51]= 0.318395

Out[52]= 0.00105871
```

- ## Simpson's Rule

- Question 1:Solve $\int_0^1 \frac{1}{1+x} \, dx$, using Simpson's rule.

In[53]:=
```
f[x_] := 1 / (1 + x);
m = 12;
a = 0; b = 1; n = m / 2; h = (b - a) / m;
```

$$\text{APPINT} = N\left[\frac{h}{3}\left(f[a] + f[b] + 2\sum_{k=1}^{m-1} f[a + 2\,k\,h] + 4\sum_{k=1}^{m} f[a + (2\,k - 1)\,h]\right)\right];$$

```
EXACTINT = N[Integrate[f[x], {x, 0, 1}]];
Error = Abs[APPINT - EXACTINT];
Print["APPINT=", APPINT]
Print["EXACTINT=", EXACTINT]
Print["Error=", Error]
```

```
APPINT=1.10324

EXACTINT=0.693147

Error=0.410096
```

In[62]:=
```
f[x_] := 1 / (1 + x);
m = Input["gives no of partition"];
a = 0; b = 1; n = m / 2; h = (b - a) / m;
```

$$\text{APPINT} = N\left[\frac{h}{3}\left(f[a] + f[b] + 2\sum_{k=1}^{n-1} f[a + 2\,k\,h] + 4\sum_{k=1}^{n} f[a + (2\,k - 1)\,h]\right)\right];$$

```
EXACTINT = N[Integrate[f[x], {x, 0, 1}]];
Error = Abs[APPINT - EXACTINT];
Print["APPINT=", APPINT]
Print["EXACTINT=", EXACTINT]
Print["Error=", Error]
```

APPINT= $\frac{1}{\$Canceled}$ 0.333333
(1.5 − 1. $Canceled PolyGamma[0., 1. + 0.5 $Canceled] + $Canceled PolyGamma[0., $Canceled] +
2. (−1. $Canceled PolyGamma[0., 0.5 + 0.5 $Canceled] +
$Canceled PolyGamma[0., 0.5 + $Canceled]))

EXACTINT=0.693147

Error=

Abs[−0.693147 + $\frac{1}{\$Canceled}$ 0.333333 (1.5 − 1. $Canceled PolyGamma[0., 1. + 0.5 $Canceled] +
$Canceled PolyGamma[0., $Canceled] + 2. (−1. $Canceled
PolyGamma[0., 0.5 + 0.5 $Canceled] + $Canceled PolyGamma[0., 0.5 + $Canceled]))]

- Question 2 : Solve $\int_0^1 \frac{1}{1+x}\,dx$, using composite Simpson's Rule.

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```
APPINT=0.694444 f[x_] := 1 / (1 + x);
a = Input[Enter the Lower Limit];
b = Input[Enter the Upper Limit];
APPINT = ((b − a) / 6) * (f[a] + 4 * f[(a + b) / 2] + f[b]);
EXACTINT = N[Integrate[f[x], {x, 0, 1}]];
Error = Abs[APPINT − EXACTINT];
Print[APPINT=, N[APPINT]]
Print[EXACTINT=, EXACTINT]
Print[Error=, Error]
```

EXACTINT=0.693147

Error=0.00129726

```
f[x_] := 1 / (1 + x);
m = Input["gives no of partition"];
a = 0; b = 1; n = m / 2; h = (b - a) / m;
```

$$\text{APPINT} = \text{N}\left[\frac{h}{3}\left(f[a] + f[b] + 2\sum_{k=1}^{n-1} f[a + 2\,k\,h] + 4\sum_{k=1}^{n} f[a + (2\,k - 1)\,h]\right)\right];$$

```
EXACTINT = N[Integrate[f[x], {x, 0, 1}]];
Error = Abs[APPINT - EXACTINT];
Print["APPINT=", APPINT]
Print["EXACTINT=", EXACTINT]
Print["Error=", Error]
```

$$\text{APPINT=}\frac{1}{\text{Null}}0.333333\,(1.5 - 1.\ \text{Null PolyGamma}[0.,\ 1. + 0.5\ \text{Null}] + \text{Null PolyGamma}[0.,\ \text{Null}] + 2.\ (-1.\ \text{Null PolyGamma}[0.,\ 0.5 + 0.5\ \text{Null}] + \text{Null PolyGamma}[0.,\ 0.5 + \text{Null}]))$$

EXACTINT=0.693147

$$\text{Error=Abs}\left[-0.693147 + \frac{1}{\text{Null}}0.333333\,(1.5 - 1.\ \text{Null PolyGamma}[0.,\ 1. + 0.5\ \text{Null}] + \text{Null PolyGamma}[0.,\ \text{Null}] + 2.\ (-1.\ \text{Null PolyGamma}[0.,\ 0.5 + 0.5\ \text{Null}] + \text{Null PolyGamma}[0.,\ 0.5 + \text{Null}]))\right]$$