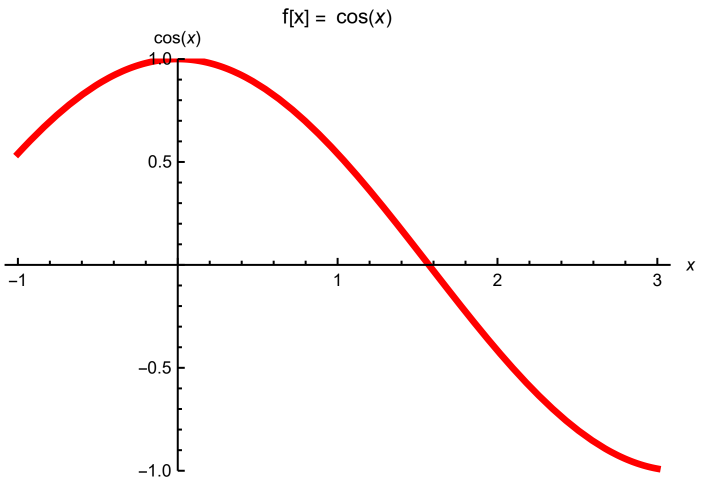
PRACTICAL QUESTIONS PRACTICE :

BISECTION METHOD

In[ ]:=
```
(*1. Solve cos[x]==0*)
```

In[ ]:=
```
f[x_] := Cos[x];
x0 = 0;
x1 = 2.0;
Nmax = 5;
eps = 0.0001;
If[N[f[x0] × f[x1]] > 0,
  Print["\nYour values do no satisfy the IVP so use new values."],
  For[i = 1, i ≤ Nmax, i++, m = (x0 + x1)/2;
   If[Abs[(x1 - x0)/2] < eps, Return[m], Print[i, "th iteration value is : ", m];
    Print["Estimated error in ", i, "th iteration is : ", (x1 - x0)/2];
    If [f[m] * f[x1] < 0, x0 = m, x1 = m]]];
  Print["\nRoot is : ", m];
  Print["Estimated error in ", i, "th iteration is : ", (x1 - x0)/2];];
Print[Plot[f[x], {x, -1, 3}, PlotRange → {-1, 1}, PlotStyle → {Red, Thickness[0.01]},
   PlotLabel → "f[x]  = " f[x], AxesLabel → {x, f[x]}]];
```

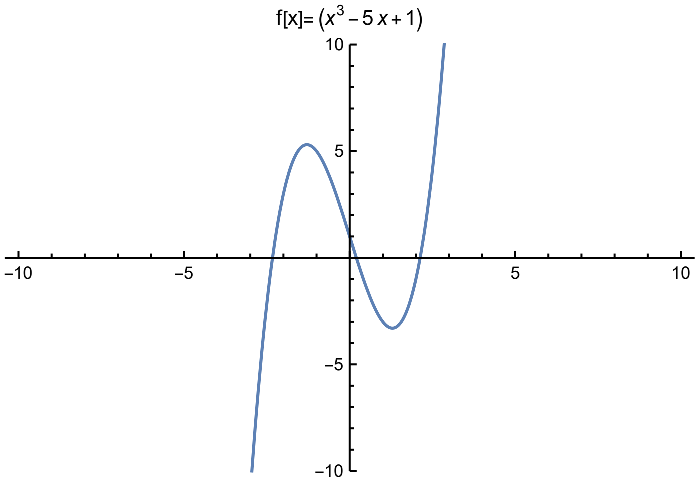
```
1th iteration value is : 1.

Estimated error in 1th iteration is : 1.

2th iteration value is : 1.5

Estimated error in 2th iteration is : 0.5

3th iteration value is : 1.75

Estimated error in 3th iteration is : 0.25

4th iteration value is : 1.625

Estimated error in 4th iteration is : 0.125

5th iteration value is : 1.5625

Estimated error in 5th iteration is : 0.0625


Root is : 1.5625

Estimated error in 6th iteration is : 0.03125
```



In[ ]:=
```
(*Solve x^3-5x+1=0*)
f[x_] := x^3 - 5 x + 1;
x0 = 0;
x1 = 0.5;
Nmax = 20;
eps = 0.0001;
If[N[f[x0] * f[x1]] > 0,
  Print["\nGiven values do not satisfy the IVP, try other values."],
  For[i = 1, i ≤ Nmax , i++, m = (x0 + x1)/2;
   If[Abs[(x0 - x1)/2] < eps, Return[m], Print[i, "th iteration value is ", m];
    Print["Estimated error in ", i, "th iteration is : ", (x1 - x0)/2];
    If[f[m] * f[x1] < 0, x0 = m, x1 = m]]];
  Print["\nRoot is : ", m];
  Print["Estimated error in ", i, "th iteration is : ", (x1 - x0)/2]];
Print[Plot[f[x], {x, -10, 10}, PlotRange → {-10, 10}, PlotLabel → "f[x]=" f[x]]];
```

```
1th iteration value is 0.25
Estimated error in 1th iteration is : 0.25
2th iteration value is 0.125
Estimated error in 2th iteration is : 0.125
3th iteration value is 0.1875
Estimated error in 3th iteration is : 0.0625
4th iteration value is 0.21875
Estimated error in 4th iteration is : 0.03125
5th iteration value is 0.203125
Estimated error in 5th iteration is : 0.015625
6th iteration value is 0.195313
Estimated error in 6th iteration is : 0.0078125
7th iteration value is 0.199219
Estimated error in 7th iteration is : 0.00390625
8th iteration value is 0.201172
Estimated error in 8th iteration is : 0.00195313
9th iteration value is 0.202148
Estimated error in 9th iteration is : 0.000976563
10th iteration value is 0.20166
Estimated error in 10th iteration is : 0.000488281
11th iteration value is 0.201416
Estimated error in 11th iteration is : 0.000244141
12th iteration value is 0.201538
Estimated error in 12th iteration is : 0.00012207
```

Out[•]= Return[0.201599]



In[ ]:=
```
(*Solve cos[x]-xe^x=0*)
f[x_] := Cos[x] - x * Exp[x];
x0 = 0;
x1 = 1;
Nmax = 20;
eps = 0.0001;
If[N[f[x0] * f[x1]] > 0,
  Print["\nGiven values do not satisfy the IVP try other values"],
  For[i = 1, i ≤ Nmax, i++, m = N[(x0 + x1)/2];
   If[Abs[(x0 - x1)/2] < eps, Return[m], Print[i, "th iteration value is : ", m];

    Print["Estimated error in ", i, "th iteration is ", (x1 - x0)/2];
    If[f[m] * f[x1] < 0, x0 = m, x1 = m]]];
  Print["\nRoot is ", m];
  Print["Estimated error in ", i, "th iteration is ", (x1 - x0)/2]];
Print[Plot[f[x], {x, -10, 10}, PlotRange → {-10, 10},
   PlotLabel → "f[x]=" f[x], AxesLabel → {x, f[x]}]];
```

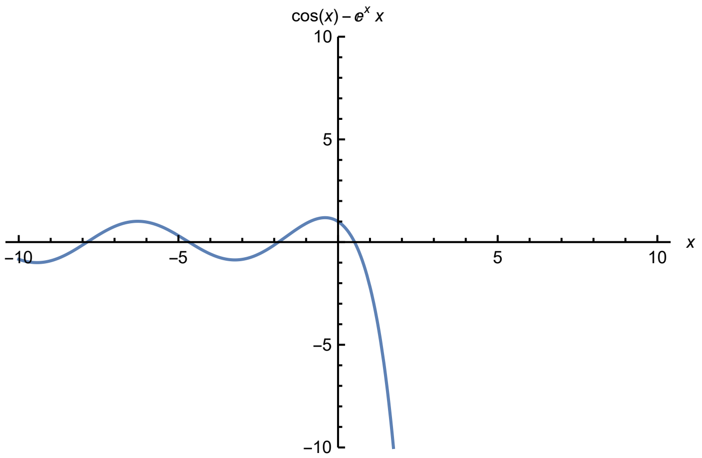
```
1th iteration value is : 0.5
```

Estimated error in 1th iteration is $\frac{1}{2}$

```
2th iteration value is : 0.75
Estimated error in 2th iteration is 0.25
3th iteration value is : 0.625
Estimated error in 3th iteration is 0.125
4th iteration value is : 0.5625
Estimated error in 4th iteration is 0.0625
5th iteration value is : 0.53125
Estimated error in 5th iteration is 0.03125
6th iteration value is : 0.515625
Estimated error in 6th iteration is 0.015625
7th iteration value is : 0.523438
Estimated error in 7th iteration is 0.0078125
8th iteration value is : 0.519531
Estimated error in 8th iteration is 0.00390625
9th iteration value is : 0.517578
Estimated error in 9th iteration is 0.00195313
10th iteration value is : 0.518555
Estimated error in 10th iteration is 0.000976563
11th iteration value is : 0.518066
Estimated error in 11th iteration is 0.000488281
12th iteration value is : 0.517822
Estimated error in 12th iteration is 0.000244141
13th iteration value is : 0.5177
Estimated error in 13th iteration is 0.00012207
```

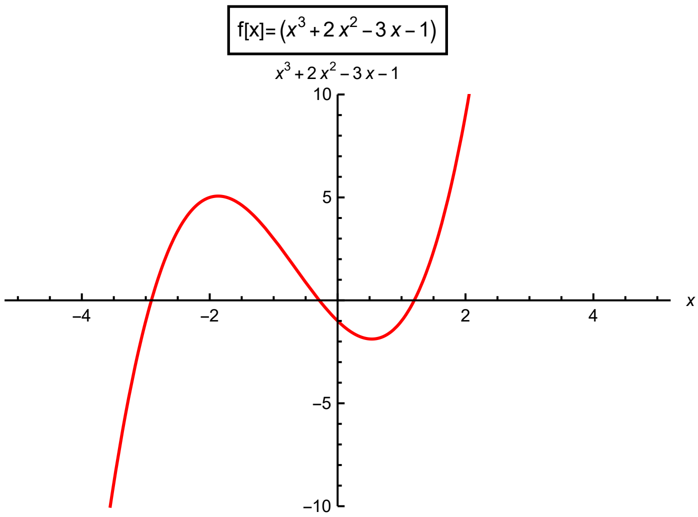
Out[ ]= Return[0.517761]

f[x]= $\left(\cos(x) - e^x\, x\right)$



```
In[ ]:= (*Solve x^3+2x^2-3x-1==0*)
f[x_] := x^3 + 2 x^2 - 3 x - 1;
a = 1;
b = 2;
Nmax = 10;
list = {};
If[N[f[a] * f[b]] ≥ 0, Print[
   "\nThe method won't apply in the interval [a,b] for given a,b\nTry new values."],
  For[i = 1, i ≤ Nmax, i++, m = N[(a + b)/2];
   list = Append[list, {i, a, m, b, f[m]}];
   If[f[m] == 0,
    Print["\nExact root of f[x] is ", m], If[f[m] * f[b] < 0, a = m, b = m]]];
  Print[TableForm[list, TableHeadings → {None, {"Iteration", "Left End Point",
        "Approximate Value", "Right End Point", "Value of func"}}]]];
Print[Plot[f[x], {x, -5, 5}, PlotRange → {-10, 10}, PlotLabel → Framed["f[x]=" f[x]],
   AxesLabel → {x, f[x]}, PlotStyle → Red]];
Print["\nRoot after ", Nmax, " iterations is ", m];
Print["\nAccuracy is ", Abs[(b - a)/2]];
```

Iteration	Left End Point	Approximate Value	Right End Point	Value of func
1	1	1.5	2	2.375
2	1	1.25	1.5	0.328125
3	1	1.125	1.25	-0.419922
4	1.125	1.1875	1.25	-0.067627
5	1.1875	1.21875	1.25	0.124725
6	1.1875	1.20313	1.21875	0.0271797
7	1.1875	1.19531	1.20313	-0.0205646
8	1.19531	1.19922	1.20313	0.00322217
9	1.19531	1.19727	1.19922	-0.00869253
10	1.19727	1.19824	1.19922	-0.00274051

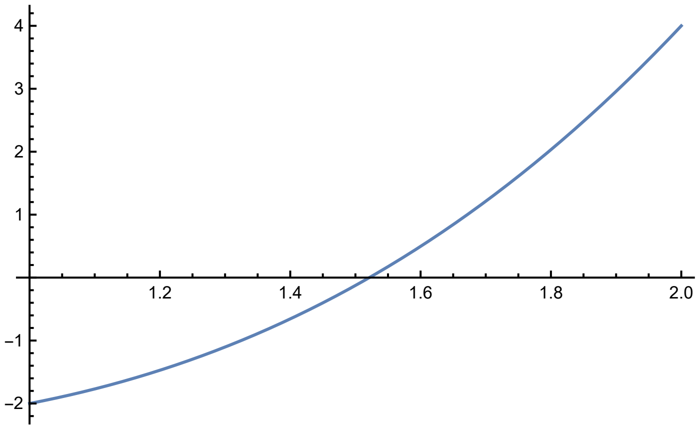


Root after 10 iterations is 1.19824

Accuracy is 0.000488281

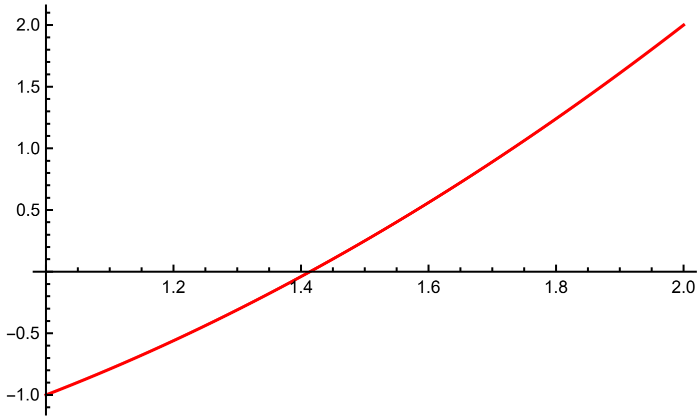
REGULA FALSI METHOD

```
In[•]:= (*Find out root of f[x]=x^3-x-2 in the interval [1,2]*)

In[•]:= f[x_] := x^3 - x - 2;
a = 1;
b = 2;
Nmax = 10;
Print[Plot[f[x], {x, a, b}]];
For[i = 0, i ≤ Nmax, i++, c = N[(b * f[a] - a * f[b])/(f[a] - f[b])];
 If[f[c] * f[b] < 0, a = c, b = c];
 Print["Iteration ", i, " = ", c]]
```



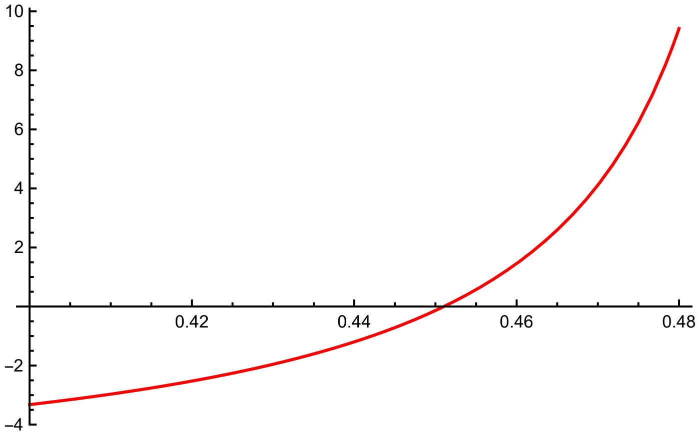

```
Iteration 0 = 1.33333
Iteration 1 = 1.46269
Iteration 2 = 1.50402
Iteration 3 = 1.51633
Iteration 4 = 1.51992
Iteration 5 = 1.52096
Iteration 6 = 1.52126
Iteration 7 = 1.52134
Iteration 8 = 1.52137
Iteration 9 = 1.52138
Iteration 10 = 1.52138
```

In[ ]:=
```
(*Evaluate square root of 2*)
f[x_] := x^2 - 2;
a = 1;
b = 2;
Nmax = 10;
Print[Plot[f[x], {x, a, b}, PlotStyle → Red]];
For[i = 1, i ≤ Nmax, i++, c = N[(a * f[b] - b * f[a])/(f[b] - f[a])];
  If[f[c] * f[b] < 0, a = c, b = c]; Print[i, "th Iteration : ", c]];
Print["The approximate value of the square root of 2 by Regula Falsi Method after ",
  Nmax, " iterations is ", c];
```




```
1th Iteration : 1.33333
2th Iteration : 1.4
3th Iteration : 1.41176
4th Iteration : 1.41379
5th Iteration : 1.41414
6th Iteration : 1.4142
7th Iteration : 1.41421
8th Iteration : 1.41421
9th Iteration : 1.41421
10th Iteration : 1.41421
The approximate value of the square root of 2 by Regula Falsi Method after
 10 iterations is 1.41421
```

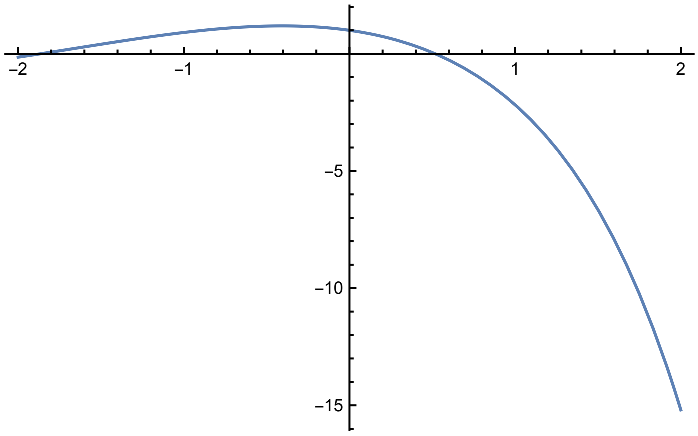
In[ ]:=
```
(*Approximate the root of the equation f[x]= Tan[Pi*x]-x-6 in [0.40,0.48],
iterations=10 *)
f[x_] := Tan[Pi * x] - x - 6;
a = 0.40;
b = 0.48;
Nmax = 10;
Print[Plot[f[x], {x, a, b}, PlotStyle → Red]];
For[i = 1, i ≤ Nmax, i++, c = N[(a * f[b] - b * f[a]) / (f[b] - f[a])];
  If[f[c] * f[b] < 0, a = c, b = c]; Print[i, "th iteration : ", c]];
Print["\nApproximate root of f(x)=", f[x], " after ", Nmax, " iterations is ", c];
```




```
1th iteration : 0.420867
2th iteration : 0.433203
3th iteration : 0.440496
4th iteration : 0.444808
5th iteration : 0.447358
6th iteration : 0.448866
7th iteration : 0.449757
8th iteration : 0.450284
9th iteration : 0.450596
10th iteration : 0.45078

Approximate root of f(x)=-6 - x + Tan[π x] after 10 iterations is 0.45078
```

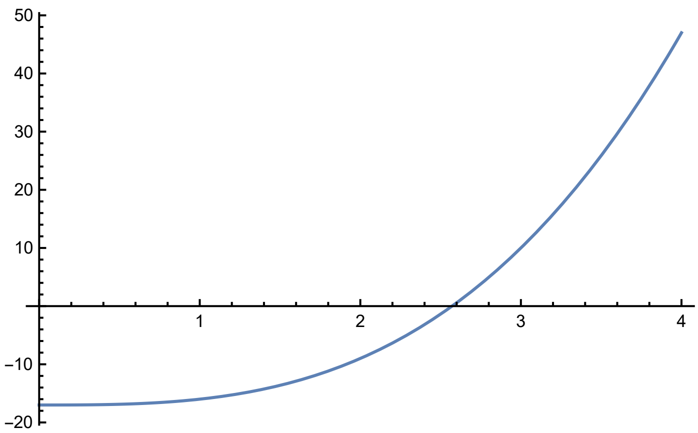
SECANT METHOD

In[ ]:=
```
(*Solve f[x]=cos[x]-x*e^x*)
f[x_] := Cos[x] - x * Exp[x];
p0 = 0;
p1 = 1;
Nmax = 10;
Print[Plot[f[x], {x, -2, 2}]];
For[i = 1, i ≤ Nmax, i++, p2 = N[(p0 * f[p1] - p1 * f[p0]) / (f[p1] - f[p0])];
  Print["Iteration ", i, " : ", p2];
  p0 = p1;
  p1 = p2;];
```




```
Iteration 1 : 0.314665
Iteration 2 : 0.446728
Iteration 3 : 0.531706
Iteration 4 : 0.516904
Iteration 5 : 0.517747
Iteration 6 : 0.517757
Iteration 7 : 0.517757
Iteration 8 : 0.517757
Iteration 9 : 0.517757
Iteration 10 : 0.517757
```

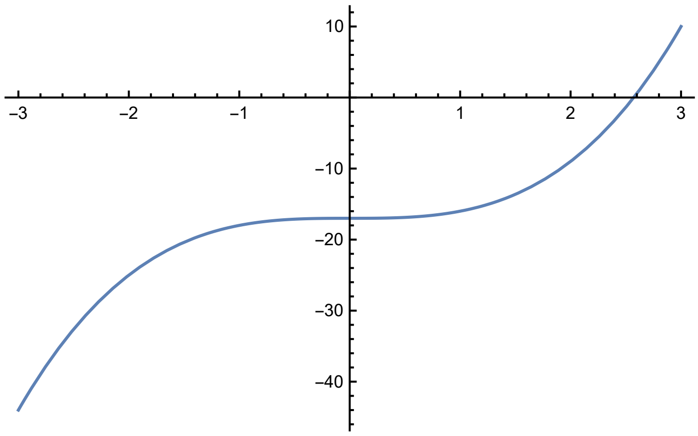
```
In[ ]:= (*Find the root of f(x)=x^3-17 taking p0=3,p1=2 after 10 iterations*)
f[x_] := x^3 - 17;
p0 = 3;
p1 = 2;
Nmax = 10;
Print[Plot[f[x], {x, 0, 4}]];
For[i = 1, i ≤ Nmax, i++, p2 = (p1 * f[p0] - p0 * f[p1]) / (f[p0] - f[p1]);
 Print["Iteration ", i, " : ", N[p2, 7]];
 p0 = p1;
 p1 = p2;]
```




```
Iteration 1 : 2.473684
Iteration 2 : 2.597352
Iteration 3 : 2.570274
Iteration 4 : 2.571271
Iteration 5 : 2.571282
Iteration 6 : 2.571282
Iteration 7 : 2.571282
Iteration 8 : 2.571282
Iteration 9 : 2.571282
Iteration 10 : 2.571282
```

NEWTON RAPHSON METHOD

```
In[ ]:= (*Use Newton Raphson Method to find the root of f(x)=x^3-17 taking p_0=3,
2 after 10 iterations*)
f[x_] := x^3 - 17;
p[0] = 3;
Print[Plot[f[x], {x, -3, 3}]];
p[n_] := p[n - 1] - f[p[n - 1]] / f'[p[n - 1]];
err[n_] := Abs[N[p[n] - CubeRoot[17], 7]];
Print[Grid[Prepend[Table[{n, N[p[n], 7], err[n]}, {n, 1, 10}],
    {"n", "p[n]", "Error[n]"}], Dividers → {{False, True}, {False, True}}]] // Quiet;
```



n	p[n]	Error[n]
1	2.629630	0.05834804
2	2.572567	0.001285091
3	2.571282	6.418429×10^{-7}
4	2.571282	1.602167×10^{-13}
5	2.571282	9.983110×10^{-27}
6	2.571282	3.876×10^{-53}
7	2.571282	$0.\times10^{-57}$
8	2.571282	$0.\times10^{-57}$
9	2.571282	$0.\times10^{-57}$
10	2.571282	$0.\times10^{-57}$

GAUSS ELIMINATION METHOD

Solve the linear system of by Gauss Elimination method

3.15 x - 1.96 y + 3.85 z = 12.95

2.13 x + 5.12 y - 2.89 z = -8.61

5.92 x + 3.05 y + 2.155 z = 6.88

```
m = {{3.15, -1.96, 3.85, 12.95}, {2.13, 5.12, -2.89, -8.61}, {5.92, 3.05, 2.155, 6.88}};
Print["\nAugmented Matrix [A:B]=", MatrixForm[m]];
m[[2]] = m[[2]] - m[[2, 1]]/m[[1, 1]] * m[[1]];
m[[3]] = m[[3]] - m[[3, 1]]/m[[1, 1]] * m[[1]];
Print[m // MatrixForm];
m[[3]] = m[[3]] - m[[3, 2]]/m[[2, 2]] * m[[2]];
Print[m // MatrixForm];
z = m[[3, 4]]/m[[3, 3]];
y = 1/m[[2, 2]] * (m[[2, 4]] - m[[2, 3]] * z);
x = 1/m[[1, 1]] * (m[[1, 4]] - m[[1, 2]] * y - m[[1, 3]] * z);
Print["\nx : ", x, "\ny : ", y, "\nz : ", z];
```

Augmented Matrix [A:B] = $\begin{pmatrix} 3.15 & -1.96 & 3.85 & 12.95 \\ 2.13 & 5.12 & -2.89 & -8.61 \\ 5.92 & 3.05 & 2.155 & 6.88 \end{pmatrix}$

$\begin{pmatrix} 3.15 & -1.96 & 3.85 & 12.95 \\ 0. & 6.44533 & -5.49333 & -17.3667 \\ 8.88178\times10^{-16} & 6.73356 & -5.08056 & -17.4578 \end{pmatrix}$

$\begin{pmatrix} 3.15 & -1.96 & 3.85 & 12.95 \\ 0. & 6.44533 & -5.49333 & -17.3667 \\ 8.88178\times10^{-16} & 0. & 0.658428 & 0.685491 \end{pmatrix}$

x : 1.71422
y : -1.80713
z : 1.0411

GAUSS JORDAN METHOD

Solve the linear system of by Gauss JORDAN method

2a+b+c-2d=-10

4a+0b+2c+d=8

3a+2b+2c+0d=7

a+3b+2c-d=-5

In[ ]:=
```
m = {{2, 1, 1, -2, -10}, {4, 0, 2, 1, 8}, {3, 2, 2, 0, 7}, {1, 3, 2, -1, -5}};
Print["\nAugmented Matrix [A:B]=", MatrixForm[m]];
n = RowReduce[m];
Print["\nRow Reduced Matrix: ", MatrixForm[n]];
{a, b, c, d} = n[[All, 5]];
Print["\na : ", a, "\nb : ", b, "\nc : ", c, "\nd : ", d];
```

Augmented Matrix [A:B] = $\begin{pmatrix} 2 & 1 & 1 & -2 & -10 \\ 4 & 0 & 2 & 1 & 8 \\ 3 & 2 & 2 & 0 & 7 \\ 1 & 3 & 2 & -1 & -5 \end{pmatrix}$

Row Reduced Matrix: $\begin{pmatrix} 1 & 0 & 0 & 0 & 5 \\ 0 & 1 & 0 & 0 & 6 \\ 0 & 0 & 1 & 0 & -10 \\ 0 & 0 & 0 & 1 & 8 \end{pmatrix}$

a : 5
b : 6
c : -10
d : 8

Q2. Find Inverse of Matrix using gauss jordan method

In[ ]:=
```
A = {{2, 2, 3, 1, 0, 0}, {2, 1, 1, 0, 1, 0}, {1, 3, 5, 0, 0, 1}};
Print["\nAugmented Matrix [A:I]=", MatrixForm[A]];
n = RowReduce[A];
Print["\nRow Reduced form : ", MatrixForm[n]];
Print["\nInverse of given matrix is", MatrixForm[n[[1 ;; 3, 4 ;; 6]]]];
```

Augmented Matrix [A:I] = $\begin{pmatrix} 2 & 2 & 3 & 1 & 0 & 0 \\ 2 & 1 & 1 & 0 & 1 & 0 \\ 1 & 3 & 5 & 0 & 0 & 1 \end{pmatrix}$

Row Reduced form : $\begin{pmatrix} 1 & 0 & 0 & 2 & -1 & -1 \\ 0 & 1 & 0 & -9 & 7 & 4 \\ 0 & 0 & 1 & 5 & -4 & -2 \end{pmatrix}$

Inverse of given matrix is $\begin{pmatrix} 2 & -1 & -1 \\ -9 & 7 & 4 \\ 5 & -4 & -2 \end{pmatrix}$

GAUSS JACOBI METHOD

Q1. Solve the given system of equations using Gauss Jacobi Method by initial approximation as X(0)=(0,0). Do 5 iterations

x1 + 2x2 = 4

5x1 - 6x2 = 3

In[1]:=
```
x1[0] = 0;
x2[0] = 0;
x1[n_] := N[4 - 2 * x2[n - 1]];
x2[n_] := N[(3 - 5 * x1[n - 1])/(-6)];
Print[Grid[Prepend[Table[{n, N[x1[n], 7], N[x2[n], 7]}, {n, 1, 5}],
    {"Iteration(n)", "x1[n]", "x2[n]"}], Dividers → {AllTrue, AllTrue}]] // Quiet;
```

Iteration(n)	x1[n]	x2[n]
1	4.	-0.5
2	5.	2.83333
3	-1.66667	3.66667
4	-3.33333	-1.88889
5	7.77778	-3.27778

Q2. Solve the given system of equations using Gauss Jacobi Method by taking initial approximation as X (0) = (0, 0, 0) . Do 5 iterations .

4 x1 - x2 - x3 = 3

-2 x1 + 6 x2 + x3 = 9

-x1 + x2 + 7 x3 = -6

In[6]:=
```
x1[0] = 0;
x2[0] = 0;
x3[0] = 0;
x1[n_] := (3 + x2[n - 1] + x3[n - 1])/4;
x2[n_] := (9 + 2 * x1[n - 1] - x3[n - 1])/6;
x3[n_] := (-6 + x1[n - 1] - x2[n - 1])/7;
Print[Grid[Prepend[Table[{n, N[x1[n], 7], N[x2[n], 7], N[x3[n], 7]}, {n, 1, 5}],
    {"Iteration(n)", "x1[n]", "x2[n]", "x3[n]"}], Dividers → {AllTrue, AllTrue}]];
```

Iteration(n)	x1[n]	x2[n]	x3[n]
1	0.7500000	1.500000	-0.8571429
2	0.9107143	1.892857	-0.9642857
3	0.9821429	1.964286	-0.9974490
4	0.9917092	1.993622	-0.9974490
5	0.9990434	1.996811	-1.000273

GAUSS SEIDEL METHOD

Q1 : Solve the given system of equations using Gauss Seidel Method by taking initial approximation as X(0) = (0, 0). Do 7 iterations.

7x1 + 2 x2 = 4

2 x1 + 6 x2 = 3

In[13]:=
```
x1[0] = 0;
x2[0] = 0;
x1[n_] := (4 - 2 * x2[n - 1])/7;
x2[n_] := (3 - 2 * x1[n])/6;
Print[Grid[Prepend[Table[{n, N[x1[n], 7], N[x2[n], 7]}, {n, 1, 7}],
    {"Iteration(n)", "x1[n]", "x2[n]"}], Dividers → All]];
```

Iteration(n)	x1[n]	x2[n]
1	0.5714286	0.3095238
2	0.4829932	0.3390023
3	0.4745708	0.3418097
4	0.4737686	0.3420771
5	0.4736923	0.3421026
6	0.4736850	0.3421050
7	0.4736843	0.3421052

Q2. Solve the given system of equations using Gauss Seidel Method by taking initial approximation as X(0) = (0, 0, 0). Do 7 iterations.

4 x1 - x2 - x3 = 3

-2 x1 + 6 x2 + x3 = 9

-x1 + x2 + 7 x3 = -6

In[18]:=
```
x1[0] = 0;
x2[0] = 0;
x3[0] = 0;
```
$$x1[n\_] := \frac{3 + x2[n-1] + x3[n-1]}{4};$$
$$x2[n\_] := \frac{9 + 2 * x1[n] - x3[n-1]}{6};$$
$$x3[n\_] := \frac{-6 + x1[n] - x2[n]}{7};$$
```
Print[Grid[Prepend[Table[{n, N[x1[n], 7], N[x2[n], 7], N[x3[n], 7]}, {n, 1, 7}],
    {"Iteration(n)", "x1[n]", "x2[n]", "x3[n]"}], Dividers → All]];
```

Iteration(n)	x1[n]	x2[n]	x3[n]
1	0.7500000	1.750000	-1.000000
2	0.9375000	1.979167	-1.005952
3	0.9933036	1.998760	-1.000779
4	0.9994951	1.999962	-1.000067
5	0.9999737	2.000002	-1.000004
6	0.9999996	2.000001	-1.000000
7	1.000000	2.000000	-1.000000

LAGRANGE INTERPOLATION POLYNOMIAL

MODULE

In[25]:=
```
LagrangePolynomial[x0_, y0_] := Module[{xi = x0, yi = y0, n, m, polynomial},
  n = Length[xi];
  m = Length[yi];
  If[m ≠ n, Print["\nList of points and values are not of same size"];
   Return[];];
```
$$\text{For}\left[i = 1,\ i \le n,\ i{+}{+},\ L[i, x\_] = \left(\prod_{j=1}^{i-1} \frac{x - xi[[j]]}{xi[[i]] - xi[[j]]}\right)\left(\prod_{j=i+1}^{n} \frac{x - xi[[j]]}{xi[[i]] - xi[[j]]}\right);\right];$$
$$\text{polynomial}[x\_] = \sum_{k=1}^{n} L[k, x] * yi[[k]];$$
```
  Return[polynomial[x]];]
```

Q1.

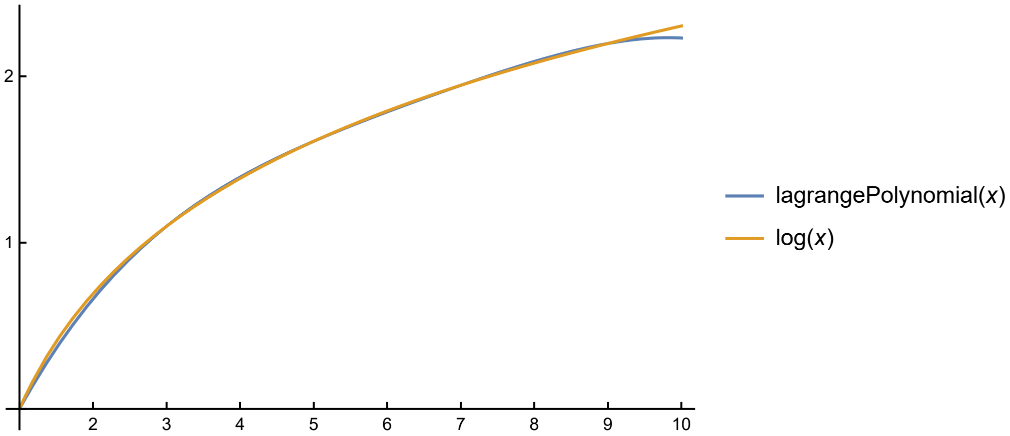
In[26]:=
```
nodes = {0, 1, 3};
values = {1, 3, 55};
resultingPolynomial[x_] = LagrangePolynomial[nodes, values];
Simplify[resultingPolynomial[x]]
```

Out[29]= $1 - 6x + 8x^2$

Q2.

In[30]:=
```
nodes = {1, 3, 5, 7, 9};
values = N[Log[nodes]];
lagrangePolynomial[x_] = LagrangePolynomial[nodes, values];
Print["Lagrange Polynomial : ", Simplify[lagrangePolynomial[x]]];
Print[Plot[{lagrangePolynomial[x], Log[x]},
   {x, 1, 10}, Ticks → {Range[0, 10]}, PlotLegends → "Expressions"]];
```

Lagrange Polynomial : $-0.987583 + 1.18991\,x - 0.223608\,x^2 + 0.0221231\,x^3 - 0.000844369\,x^4$



TRAPEZOIDAL RULE

Q1 . Intergrate $\int_0^2 x^2 \operatorname{Sin}[x]\, dx$ using Trapezoidal rule with 5 subintervals

In[35]:=
```
f[x_] := x^2 * Sin[x];
a = 0;
b = 2;
n = 5;(*No of intervals*)
h = (b - a)/n;
Sol = h/2 * (f[a] + 2 * Sum[f[i], {i, a + h, b - h, h}] + f[b]);
Print["\nSolution of the given integral is ", N[Sol]];
```

```
Solution of the given integral is 2.49642
```

Q2 . Integrate $\int_0^1 \frac{1}{1+x}\, dx$ using Trapezoidal rule with 4 equal intervals

In[42]:=
```
f[x_] := 1/(1 + x);
a = 0;
b = 1;
n = 4;
h = (b - a)/n;
Sol = h/2 * (f[a] + 2 * Sum[f[i], {i, a + h, b - h, h}] + f[b]);
Print["\nSolution of the given integral is ", N[Sol]];
```

```
Solution of the given integral is 0.697024
```

Q3 . Integrate $\int_1^5 x^3 \, dx$ using Trapezoidal Rule taking n = 10 and calculate the absolute error in the approximation.

In[49]:=
```
f[x_] = x^3;
a = 1;
b = 5;
n = 10;
h = (b - a)/n;
Sol = h/2 * (f[a] + 2 * Sum[f[i], {i, a + h, b - h, h}] + f[b]);
Print["\nSolution of the given integral is ", N[Sol]];
actual = Integrate[x^3, {x, 1, 5}];
Print["The absolute error is ", N[Abs[actual - Sol]]];
```

```
Solution of the given integral is 156.96
The absolute error is 0.96
```

Simpson’s 1/3rd rule

Q. Calculate the integral : $\int_0^2 e^{-x^2} \, dx$ using Simpson’s 1/3rd rule taking n=10

In[58]:=
```
f[x_] := Exp[-x^2];
a = 0;
b = 2;
n = 10;
h = (b - a)/n;
oddSum = Sum[f[i], {i, a + h, b - h, 2 * h}];
evenSum = Sum[f[i], {i, a + 2 h, b - 2 h, 2 * h}];
sol = h/3 * (f[a] + 4 * oddSum + 2 * evenSum + f[b]);
Print["\nValue of given integral using Simpson's method is ", N[sol]];
```

```
Value of given integral using Simpson's method is 0.882075
```

ODE using Euler’ s Method

ODE using Euler' s Method

Q. Solve the initial value problem $\frac{dy}{dx} = \frac{e^x}{y}$, y (0) = 1 for y (1) using Euler' s method

In[77]:=
```
x[0] = 0;
y[0] = 1;
a = 0;
b = 1;
n = 10;
h = (b - a)/n;
f[x_, y_] := Exp[x]/y;
x[j_] := x[j - 1] + h;
y[j_] := y[j - 1] + h * f[x[j - 1], y[j - 1]];
Print[Grid[Prepend[Table[{i, N[x[i], 4], N[y[i], 7]}, {i, 1, 10}],
    {"j", "x[j]", "y[j]"}], Dividers → All]];
```

j	x[j]	y[j]
1	0.1000	1.100000
2	0.2000	1.200470
3	0.3000	1.302214
4	0.4000	1.405873
5	0.5000	1.511986
6	0.6000	1.621030
7	0.7000	1.733435
8	0.8000	1.849606
9	0.9000	1.969931
10	1.000	2.094788

ODE using Modified Euler's Method

Q. Solve the initial value problem $\frac{dy}{dx} = x + y$, y (0) =
1 for y (0.3) using Euler ' s method

In[87]:=
```
x[0] = 0;
y[0] = 1;
a = 0;
b = 0.3;
n = 10;
h = (b - a)/n;
f[x_, y_] := x + y;
x[j_] := x[j - 1] + h;
y[j_] := y[j - 1] + h * f[x[j - 1] + h/2, y[j - 1] + h/2 * f[x[j - 1], y[j - 1]]];
Print[Grid[Prepend[Table[{j, N[x[j], 4], N[y[j], 7]}, {j, 1, 10}],
    {"j", "x[j]", "y[j]"}], Dividers → All]];
```

j	x[j]	y[j]
1	0.03	1.0309
2	0.06	1.06365
3	0.09	1.09832
4	0.12	1.13495
5	0.15	1.17362
6	0.18	1.21437
7	0.21	1.25728
8	0.24	1.30241
9	0.27	1.34983
10	0.3	1.3996