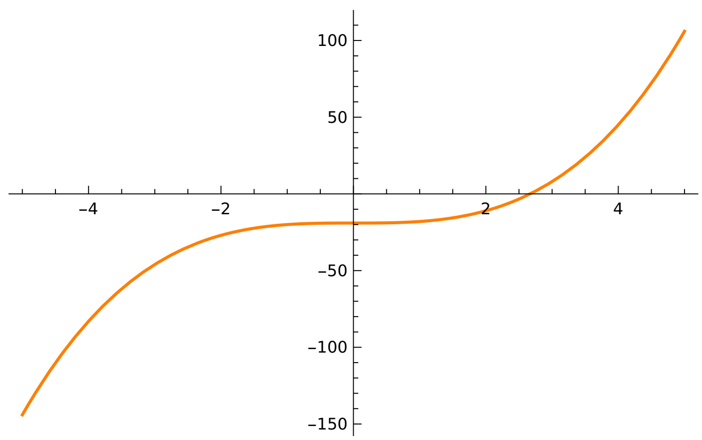
In[65]:=

```
bisectionMethod[a0_, b0_, n_, f_] := Module[{},
a = N[a0];
b = N[b0];
m = (a + b) / 2.0;
If[f[a] * f[b] > 0,
Print["Bisection method can not be applied as f(a).f(b)>0"];
Return[]];
For[i = 1, i ≤ n, i++,
If[Sign[f[a]] == Sign[f[m]], a = m, b = m];
m = (a + b) / 2.0;
Print["After iteration :", i, "Root=", m];
];
Print["Accuracy=", Abs[(b - a) / 2.0]];
Print["Approximate root of the equation is=",
NumberForm[m, 8]]];
f1[x_] = x^3 - 19;
Plot[f1[x], {x, -5, 5}]
bisectionMethod[2, 3, 15, f1]
```

Out[67]=



After iteration :1Root=2.75

After iteration :2Root=2.625

After iteration :3Root=2.6875

After iteration :4Root=2.65625

After iteration :5Root=2.67188

After iteration :6Root=2.66406

After iteration :7Root=2.66797

After iteration :8Root=2.66992

After iteration :9Root=2.66895

After iteration :10Root=2.66846

After iteration :11Root=2.66821

After iteration :12Root=2.66833

After iteration :13Root=2.6684

After iteration :14Root=2.66843

After iteration :15Root=2.66841

Accuracy=0.0000152588

Approximate root of the equation is=2.6684113

In[99]:=
```
A = {{1, -2, 1}, {-1, 10, 2}, {-2, -5, 10}};
b = {7, 12, 18};
dimA = Dimensions[A]
m = dimA[[1]]
n = dimA[[2]]
Det[A]
Y = Inverse[A]
X = Y.b
gaussJordan[A_, b_] := Module[{dimA, m, n, Y, X},
dimA = Dimensions[A];
m = dimA[[1]];
n = dimA[[2]];
If[m ≠ n, Print ("Jordan Method Cannot be applied"), Return[]];
If[Det [A] == 0, Print["Jordan Method is not Applicable"]; Return[]];
Y = Inverse[A];
    X = b.Y]
```

Out[101]=

$\{3, 3\}$

Out[102]=

3

Out[103]=

3

Out[104]=

123

Out[105]=

$$\begin{pmatrix} \frac{110}{123} & \frac{5}{41} & -\frac{14}{123} \\ \frac{2}{41} & \frac{4}{41} & -\frac{1}{41} \\ \frac{25}{123} & \frac{3}{41} & \frac{8}{123} \end{pmatrix}$$

Out[106]=

$$\left\{\frac{698}{123}, \frac{44}{41}, \frac{427}{123}\right\}$$

In[108]:=

```
A = {{1, -2, 1}, {-1, 10, 2}, {-2, -5, 10}};
B = {7, 12, 18};
X0 = {0, 0, 0}
dimA = Dimensions[A];
m = dimA[[1]];
n = dimA[[2]];
If[m ≠ n,
Print["Gauss Jacobi Method Cannot be applied"],
Return];
D1 = DiagonalMatrix[Diagonal[A]]
L = LowerTriangularize[A] // MatrixForm
U = UpperTriangularize[A] // MatrixForm
For[i = 1, i ≤ 10, i++, X1 = LinearSolve[D1, -(L + U).X0 + B];
Print["X", i, "=", X1]]
```

Out[110]=

{0, 0, 0}

Out[115]=

$$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 10 \end{pmatrix}$$

Out[116]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}$$

Out[117]//MatrixForm=

$$\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}$$

$$X1=\left\{\frac{1}{10}\left(70-10\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right),\right.$$
$$\left.\frac{1}{10}\left(12-\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right),\ \frac{1}{10}\left(18-\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right)\right\}$$

$$X2=\left\{\frac{1}{10}\left(70-10\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right),\right.$$
$$\left.\frac{1}{10}\left(12-\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right),\ \frac{1}{10}\left(18-\left(\begin{pmatrix} 1 & -2 & 1 \\ 0 & 10 & 2 \\ 0 & 0 & 10 \end{pmatrix}+\begin{pmatrix} 1 & 0 & 0 \\ -1 & 10 & 0 \\ -2 & -5 & 10 \end{pmatrix}\right).\{0,0,0\}\right)\right\}$$

$$X3=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X4=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X5=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X6=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X7=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X8=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X9=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$

$$\left.\frac{1}{10}\left(12-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\ \frac{1}{10}\left(18-\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right)\right\}$$

$$X10=\left\{\frac{1}{10}\left(70-10\left(\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right),\right.$$
$$\left.\frac{1}{10}\left(12-\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right),\ \frac{1}{10}\left(18-\left(\begin{pmatrix}1&-2&1\\0&10&2\\0&0&10\end{pmatrix}+\begin{pmatrix}1&0&0\\-1&10&0\\-2&-5&10\end{pmatrix}\right).\{0,0,0\}\right)\right\}$$

In[1]:=
```
nodes = {0, 1, 3}
values = {3, 8, 29}
P[x_] = lagrangePolynomial[nodes, values]
lagrangePolynomial[nodes_, values_] := Module[
{xi, fi, n, m, poly},
xi = nodes;
fi = values;
n = Length[xi];
m = Length[fi];
If[n ≠ m, Print["List of points and function values are not of the same size"];
        Return[];];
For[i = 1, i ≤ n, i++, L[i_, x_] := (Product[(x - xi[[j]]) / (xi[[i]] - xi[[j]]),  {j, 1, i - 1}]) *
(Product[(x - xi[[j]]) / (xi[[i]] - xi[[j]]),  {j, i + 1, n}]);];
poly[x_] = Sum[(L[k, x] * fi[[k]]), {k, 1, n}];
Return[poly[x]]];
Simplify[P[x]]
Integrate[Exp[-x^2], {x, 0, 2}] // N
```

Out[1]= {0, 1, 3}

Out[2]= {3, 8, 29}

Out[3]= lagrangePolynomial({0, 1, 3}, {3, 8, 29})

Out[5]= $\frac{11\,x^2}{6}+\frac{19\,x}{6}+3$

Out[6]= 0.882081

In[17]:=
```
simpson[a_, b_, f_] := (b - a) * (f[a] + f[b] + 4 * f[(a + b) / 2]) / 6;
f1[x_] := 1 / (3 + x);
simpson[1, 2, f1] // N
Integrate[f1[x], {x, 1, 2}] // N
```

Out[19]=

0.223148

Out[20]=

0.223144

In[75]:=
```
eulerMethodN[a0_, b0_, f_, n_, alpha_] := Module[{},
a = N[a0];
b = N[b0];
h = (b - a) / n;
ti = Table[a + (j - 1) * h, {j, 1, n + 1}];
wi = Table[0, {n + 1}];
wi[[1]] = alpha;
For[i = 1, i ≤ n, i++,
wi[[i + 1]] = wi[[i]] + h * f[ti[[i]], wi[[i]]];
Print["i=", i, ", ti=", ti[[i]], ", wi=", wi[[i]]]];];
f[t_, x_] = 2 + x / t;
eulerMethodN[1, 3, f, 10, 1]
```

```
i=1, ti=1., wi=1
i=2, ti=1.2, wi=1.6
i=3, ti=1.4, wi=2.26667
i=4, ti=1.6, wi=2.99048
i=5, ti=1.8, wi=3.76429
i=6, ti=2., wi=4.58254
i=7, ti=2.2, wi=5.44079
i=8, ti=2.4, wi=6.33541
i=9, ti=2.6, wi=7.26336
i=10, ti=2.8, wi=8.22208
```