```
Bisection[a0_, b0_, k_] :=
 Module[{},
  a = N[a0];
  b = N[b0];
  m = (a + b) / 2;
  i = 0;
  output = {{i, a, b, m, f[a], f[b], f[m], Sign[f[a] * f[m]]}};
  While[i < k, If[Sign[f[b]] * Sign[f[m]] < 0, a = m, b = m;];
   m = (a + b) / 2;
   i = i + 1;
   output = Append[output, {i, a, b, m, f[a], f[b], f[m], Sign[f[a] * f[m]]}];];
  Print[
   NumberForm[
    TableForm[output,
     TableHeadings → {None,
        {"i", "a0", "a1", "a2", "f[a0]", "f[a1]", "f[a2]", "Sign[f[a0]*f[a2]]"}}], 16]];
  Print["m= ", NumberForm[m, 16]];]
f[x_] := x^3 - 5 * x + 1
Plot[f[x], {x, 0, 1}, PlotStyle → {Thick}, AxesLabel → {x, y}]
Print["y=f[x]= ", f[x]];
Bisection[0, 1, 5]
```

```
Secant[a0_, b0_, n_] :=
 Module[{},
  a = N[a0];
  b = N[b0];
  c = (a * f[b] - b * f[a]) / (f[b] - f[a]);
  i = 0;
  Output = {{i, a, b, c, f[c]}};
  While[i < n, a = b; b = c;
   c = (a * f[b] - b * f[a]) / (f[b] - f[a]);
   i = i + 1;
   Output = Append[Output, {i, a, b, c, f[c]}];];
  Print[
   NumberForm[
    TableForm[Output, TableHeadings → {None, {"i", "a", "b", "f[c]"}}], 16]];
  Print["c= ", NumberForm[c, 16]];]
f[x_] := x^3 - 5 * x + 1
Plot[f[x], {x, 0, 1}, PlotStyle → {Thick}, AxesLabel → {x, y}]
Print["y=f[x]= ", f[x]];
Secant[0, 1, 6]
```

```
LUDecom[A0_, n_] :=
  Module[{A = A0, i, p}, U = A0; L = IdentityMatrix[n];
   Print[MatrixForm[L], MatrixForm[U], "=", MatrixForm[A0]];
   For[p = 1, p ≤ n - 1, p++,
    For[i = p + 1, i ≤ n, i++,
      m = A[[i,p]] / A[[p,p]];
      L[[i,p]] = m;
      A[[i]] = A[[i]] - m A[[p]] ;
      U = A;
      Print[MatrixForm[L], MatrixForm[U], "=", MatrixForm[A0]];];];];
Print["L", "=", MatrixForm[L]];
Print["U", "=", MatrixForm[U]];
A = {{4, 2, 3}, {-3, 1, 4}, {2, 4, 5}};
LUDecom[A, 3]
```

$$A = \begin{pmatrix} 4 & 2 & 3 \\ -3 & 1 & 4 \\ 2 & 4 & 5 \end{pmatrix};$$

```
Jacobi[A0_, B0_, X0_, max_] :=
  Module[{A = N[A0], B = N[B0], i, j, k = 0, n = Length[X0], X = X0, Xold = X0},
   Print["X", 0, "=", X];
   While[k < max, For[i = 1, i ≤ n, i = i + 1,
     X[[i]] = (B[[i]] + A[[i, i]] * Xold[[i]] - Sum[A[[i, j]] * Xold[[j]], {j, 1, n}]) / A[[i, i]]];
    Print["X", k + 1, "=", X];
    Xold = X;
    k = k + 1;];];
A0 = {{4, 1, 0, 1}, {1, 4, 1, 0}, {0, 1, 4, 1}, {1, 0, 1, 4}};
B0 = {2, -2, 2, -2};
X0 = {0, 0, 0, 0};
Jacobi[A0, B0, X0, 20];
```

$$X[[i]] = \left(B[[i]] + A[[i,i]] * Xold[[i]] - \sum_{j=1}^{n} A[[i,j]] * Xold[[j]]\right) \Big/ A[[i,i]]$$

```
Seidel[A0_, B0_, X0_, max_] :=
  Module[{A = N[A0], B = N[B0], i, j, k = 0, n = Length[X0], X = X0, Xold = X0},
   Print["X", 0, "=", X];
   While[k < max, For[i = 1, i ≤ n, i = i + 1,
     X[[i]] = (B[[i]] - Sum[A[[i, j]] * X[[j]], {j, 1, i-1}] - Sum[A[[i, j]] * Xold[[j]], {j, i+1, n}]) / A[[i, i]]];
    Print["x", k + 1, "=", NumberForm[X, 10]];
    Xold = X;
    k = k + 1;];];
A0 = {{2, -1, 0, 0}, {-1, 2, -1, 0}, {0, -1, 2, -1}, {0, 0, -1, 2}};
B0 = {1, 0, 0, 1};
X0 = {0.5, 0.5, 0.5, 0.5};
Seidel[A0, B0, X0, 20]
```

```
sum = 0;
points = {{10, 0.1736}, {20, 0.3420}, {30, 0.5}, {40, 0.6028}, {50, 0.7660}};
n = Length[points]
y = points[[All, 1]]
f = points[[All, 2]]
dd[k_] :=
 Sum[(f[[i]] / Product[If[Equal[j, i], 1, (y[[i]] - y[[j]])], {j, 1, k}]), {i, 1, k}]
p[x_] = Sum[(dd[i] * Product[If[i ≤ j, 1, x - y[[j]]], {j, 1, i - 1}]), {i, 1, n}]
Simplify[p[x]]
Evaluate[p[25]]
```

```
Trap[a0_, b0_, n0_] :=
 Module[{a = N[a0], b = N[b0], k, n = n0, X}, h = (b - a) / n;
  X_k_ = a + k * h;
  Return[h/2 (f[a] + f[b]) + h Sum[f[X_k], {k, 1, n-1}];]
f[x_] := 1/(1 + x);
N[Trap[0, 1, 5]]
```

```
Simp[a0_, b0_, n0_] :=
 Module[{a = N[a0], b = N[b0], k, n = n0, X}, h = (b - a) / (2 * n);
  X[k_] = a + k * h;
  Return[h/3 * (f[a] + f[b]) + (2 h)/3 * Sum[f[X[2 k]], {k, 1, n-1}] + (4 h)/3 * Sum[f[X[2 k-1]], {k, 1, n}];]
f[x_] := 1/(1 + x);
N[Simp[0, 1, 4]]
```

$$\mathrm{Return}\left[\frac{h}{3}*(f[a]+f[b])+\frac{2h}{3}*\sum_{k=1}^{n-1}f[X_{2k}]+\frac{4h}{3}*\sum_{k=1}^{n}f[X_{2k-1}];\right]$$

```
Euler[{t_, y_}] := {t + h, y + h * f[t, y]}
f[t_, y_] := 1 + (y / t)
h = 0.5
points = NestList[Euler, {1, 1}, 10]
TableForm[points, TableHeadings → {Automatic, {"t_i", "y_i"}}]
```

```
RK[a0_, b0_, α_, m0_] :=
 Module[{a = a0, b = b0, j, m = m0}, h = (b - a) / m;
  Y = T = Table[0, {m + 1}];
  T[[1]] = a;
  Y[[1]] = α;
  For[j = 1, j ≤ m, j++,
   K1 = h f[T[[j]], Y[[j]]];
   K2 = h f[T[[j]] + h/2, Y[[j]] + K1/2];
   K3 = h f[T[[j]] + h/2, Y[[j]] + K2/2];
   K4 = h f[T[[j]] + h, Y[[j]] + K3];
   Y[[j + 1]] = Y[[j]] + 1/6 (K1 + 2 K2 + 2 K3 + K4);
   T[[j + 1]] = a + h j;];
  Return[Transpose[{T, Y}]]]
f[t_, y_] := 1 + y/t;
points = RK[1, 5, 1, 8];
TableForm[points, TableHeadings → {Automatic, {"t_i", "y_i"}}]
```

```
lagrange[x0_, f0_] :=
 Module[{xi = x0, fi = f0, n, m, polynomial},
  n = Length[xi];
  m = Length[fi];
  For[i = 1, i ≤ n, i++,
   L[i, x_] = (∏_{j=1}^{i-1} (x - xi[[j]]) / (xi[[i]] - xi[[j]])) ×
      (∏_{j=i+1}^{n} (x - xi[[j]]) / (xi[[i]] - xi[[j]]));];
  polynomial[x] = ∑_{k=1}^{n} L[k, x] * fi[[k]];
  Return[polynomial[x]];]
nodes = {0, 1, 2, 3};
values = {0, 1.7183, 6.3891, 19.0855};
lagrangepolynomial[x_] = lagrange[nodes, values]
lagrangepolynomial[x_] = Simplify[lagrangepolynomial[x]]
Print["Lagrange Polynomial=", lagrangepolynomial[x]]
lagrangepolynomial[1.5] + 1
```

```
NewtonRaphson[x0_, n_, f_] :=
  Module[{xk1, xk = N[x0]},
   k = 0;
   Output = {{k, x0, f[x0]}};
   While[k < n, fPrimexk = f'[xk];
    If[fPrimexk == 0, Print["The Derivative of Function at", k,
      "th iteration is zero,We cannot proceed further with the iterative scheme"];
     Break[]];
    xk1 = xk - f[xk] / fPrimexk;
    xk = xk1;
    k++;
    Output = Append[Output, {k, xk, f[xk]}];];
   Print[
    NumberForm[TableForm[Output, TableHeadings → {None, {"k", "xk", "f[xk]"}}], 10]];
   Print["Root After", n, "iterations xk=", NumberForm[xk, 10]];
   Print["Function value at approximated root,f[xk]=", NumberForm[f[xk], 6]];];
f[x_] := x^3 - 5 * x + 1
Plot[f[x], {x, 0, 1}, PlotStyle → {Thick}, AxesLabel → {x, y}]
Print["y=f[x]=", f[x]];
NewtonRaphson[0.5, 5, f]
```