Lagrange's Interpolating Polynomial

In[ ]:=

$$(*y=f(X)=Pn(x)=\frac{(x-x1)(x-x2)....(x-xn)}{(x0-x1)(x0-x2)....(x0-xn)}*f(x0)+\frac{(x-x0)(x-x2)....(x-xn)}{(x1-x0)(x1-x2)...(x1-xn)}*f(x1)+.........+\frac{(x-x0)(x-x1)....(x-x_{n-1})}{(x_n-x0)(x_n-x1)..(x_n-x_{n-1})}*f(x_n)*)$$

In[ ]:=

```
LagrangePolynomial[x0_, f0_] :=
 Module[{xi = x0 , fi = f0, n, m, Polynomial},
  n = Length[xi];
  m = Length[fi];
  If[n ≠ m,
   Print["List of points and function value are not of the same size"];
   Return[];];
  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]];]
```

Ques-1

In[ ]:=

```
nodes = {0, 1, 3}
value = {1, 3, 55}
LagrangePolynomial[nodes, value]
```

Out[ ]= {0, 1, 3}

Out[ ]= {1, 3, 55}

Out[ ]= $\frac{1}{3}\times(1-x)\times(3-x)+\frac{3}{2}\times(3-x)\,x+\frac{55}{6}\times(-1+x)\,x$

In[ ]:=

```
Simplify[LagrangePolynomial[nodes, value] ]
```

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

Newton Divided Difference Interpolating Polynomial

In[•]:=
```
NthDivideDiff[x0_, f0_, startindex_, endindex_] :=
  Module[{x = x0, f = f0, i = startindex, j = endindex, answer},
   If[i == j, Return[f[[i]]],
     answer =
      (NthDivideDiff[x, f, i + 1, j] - NthDivideDiff[x, f, i, j - 1]) / (x[[j]] - x[[i]]);
     Return[answer]];];
NewtonDDPoly[x0_, f0_] :=
  Module[{x1 = x0, f = f0, n, NewtonPolynomial, k, j},
   n = Length[x1];
   NewtonPolynomial[y_] = 0;
   For[i = 1, i ≤ n, i++,
    Prod[y_] = 1;
    For[k = 1, k ≤ i - 1, k++, Prod[y_] = Prod[y] * (y - x1[[k]])];
    NewtonPolynomial[y_] =
     NewtonPolynomial[y] + NthDivideDiff[x1, f, 1, i] * Prod[y]];
   Return[NewtonPolynomial[y]];];
```

Ques-1

In[•]:=
```
nodes = {0, 1, 3};
value = {1, 3, 55};
NewtonPoly[y_] = NewtonDDPoly[nodes, value]
NewtonPoly[y_] = Simplify[NewtonPoly[y]]
NewtonPoly[2]
```

Out[•]= $1 + 2y + 8 \times (-1 + y)\, y$

Out[•]= $1 - 6y + 8y^2$

Out[•]= 21