Practical 10
Newton Interpolation

Q. For the following set of points, find out Newton Interpolating polynomial

$x_1 = 0, x_2 = 1, x_3 = 3$

$f(x_1) = 1, f(x_2) = 3, f(x_3) = 55.$

Further approximate the value of f at x= 2, using the resulted polynomial.

```
NthDividedDiff[x0_, f0_, startindex_, endindex_] :=
 Module[{x = x0, f = f0, i = startindex, j = endindex, answer},
  If[i == j, Return[f[[i]]],
   answer = (NthDividedDiff[x, f, i + 1, j] -
       NthDividedDiff[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] +
      NthDividedDiff[x1, f, 1, i] * prod[y]];
   Return[newtonPolynomial[y]];
  ];
nodes = {0, 1, 3};
values = {1, 3, 55};
NewtonPoly[y_] = NewtonDDPoly[nodes, values]
```

$1 + 2y + 8(-1 + y)y$

```
NewtonPoly[y_] = Simplify[NewtonPoly[y]]
```

$1 - 6y + 8y^2$

```
NewtonPoly[2]
```

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Q. For the following set of points, find out Newton Interpolating polynomial

$x_1 = 0, x_2 = 0.1, x_3 = 0.2, x_4 = 0.3, x_5 = 0.4$

$f(x_1) = 1, f(x_2) = 1.095, f(x_3) = 1.179, f(x_4) = 1.251, f(x_5) = 1.310.$

Further approximate the value of f at x= 0.15 and 0.25, using the resulted polynomial.

```
nodes = {0, 0.1, 0.2, 0.3, 0.4};
values = {1, 1.095, 1.179, 1.251, 1.310};
NewtonPoly[y_] = NewtonDDPoly[nodes, values]
```

$1 + 0.95\, y - 0.55\, (-0.1 + y)\, y - 0.166667\, (-0.2 + y)\, (-0.1 + y)\, y + 3.47014 \times 10^{-13}\, (-0.3 + y)\, (-0.2 + y)\, (-0.1 + y)\, y$

```
poly[y_] = Simplify[NewtonPoly[y]]
```

$3.47014 \times 10^{-13}\, (-4.80288 \times 10^{11} + y)\, (-1.8832 + y)\, (0.775661 + y)\, (4.10754 + y)$

```
poly[0.15]
```

1.13844

```
poly[.25]
```

1.21656