Practical 9

Lagrange Interpolation

Lagrange Interpolation

Q. Find the unique polynomial of degree 2 or less such that f(0) = 1, f(1) = 3, f(3) = 55.

```
Lagrange[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 values are not of
     same size"]; Return[];];
  For[i = 1, i ≤ n, i++, L[i, x_] =
```

$$\left(\prod_{j=1}^{i-1} \frac{x - xi[[j]]}{xi[[i]] - xi[[j]]}\right) \left(\prod_{j=i+1}^{n} \frac{x - xi[[j]]}{xi[[i]] - xi[[j]]}\right);];$$

$$polynomial[x\_] = \sum_{k=1}^{n} L[k, x] * fi[[k]];$$

```
  Return[polynomial[x]];]
nodes = {0, 1, 3}; values = {1, 3, 55};
lagrangepolynomial[x_] = Lagrange[nodes, values]
```

$$\frac{1}{3}(1 - x)(3 - x) + \frac{3}{2}(3 - x)\,x + \frac{55}{6}(-1 + x)\,x$$

```
lagrangepolynomial[x_] =
  Simplify[lagrangepolynomial[x]];
Print["Lagrange Polynomial = ",
  lagrangepolynomial[x]];
```

Lagrange Polynomial $= 1 - 6x + 8x^2$

Q. Find the unique polynomial of degree 2 or less such that f (1) = 1, f (3) = 27, f (4) = 64.
Estimate f(1.5).

```
nodes = {1, 3, 4}; values = {1, 27, 64};
lagrangepolynomial[x_] = Lagrange[nodes, values]
```

$$\frac{1}{6}(3-x)(4-x)+\frac{27}{2}(4-x)(-1+x)+\frac{64}{3}(-3+x)(-1+x)$$

```
lagrangepolynomial[x_] =
  Simplify[lagrangepolynomial[x]];
Print["Lagrange Polynomial = ",
  lagrangepolynomial[x]];
```

Lagrange Polynomial = $12-19x+8x^2$

```
lagrangepolynomial[1.5]
```

1.5