# Practical 6

# Prakhar Khugshal | B.Sc (Hons) Computer Science | IV Semester | 20211441

## Lagrange Interpolation Polynomial

In[44]:=
```
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 values are not of 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]];]
```

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# Q1

In[45]:=
```
nodes = {0, 1, 3};
values = {1, 3, 55};
LagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
Expand[1/3 (1 - x) (3 - x) + 3/2 (3 - x) x + 55/6 (-1 + x) x]
```

Out[47]= $\frac{1}{3}(1-x)(3-x)+\frac{3}{2}(3-x)x+\frac{55}{6}(-1+x)x$

Out[48]= $1-6x+8x^2$

In[49]:=
```
nodes = {0, 1, 3};
values = {1, 3};
LagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

List of points  and function values are not of same size

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# P2

In[52]:=
```
nodes = {1, 3, 5, 7, 9};
values = {N[Log[1]], N[Log[3]], N[Log[5]], N[Log[7]], N[Log[9]]};
LagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

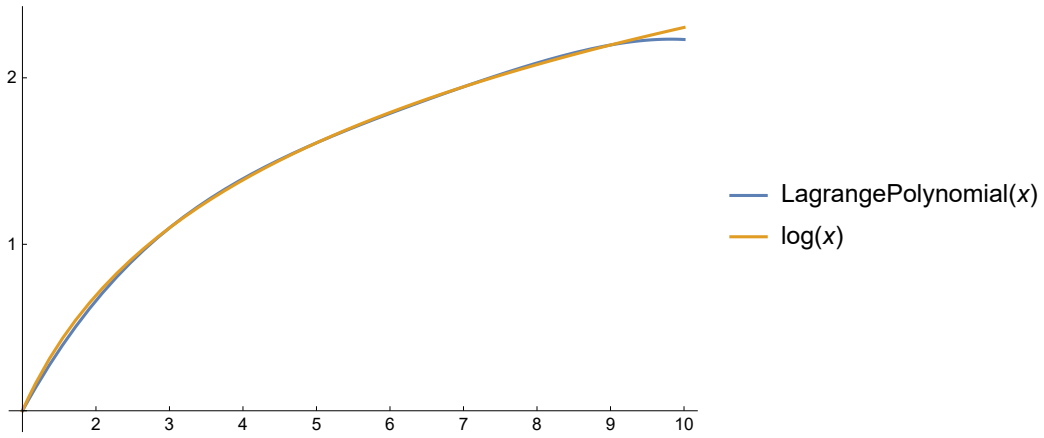
Out[54]=
$$0. + 0.0114439\,(5-x)\,(7-x)\,(9-x)\,(-1+x) + 0.0251475\,(7-x)\,(9-x)\,(-3+x)\,(-1+x) + 0.0202699\,(9-x)\,(-5+x)\,(-3+x)\,(-1+x) + 0.00572194\,(-7+x)\,(-5+x)\,(-3+x)\,(-1+x)$$

In[55]:=
```
Simplify[0.` + 0.011443878006959476` (5 - x) (7 - x) (9 - x) (-1 + x) +
  0.025147467381782817` (7 - x) (9 - x) (-3 + x) (-1 + x) +
  0.020269897385992844` (9 - x) (-5 + x) (-3 + x) (-1 + x) +
  0.005721939003479738` (-7 + x) (-5 + x) (-3 + x) (-1 + x)]
```

Out[55]=
$$-0.987583 + 1.18991\,x - 0.223608\,x^2 + 0.0221231\,x^3 - 0.000844369\,x^4$$

In[56]:=
```
Plot[{LagrangePolynomial[x], Log[x]}, {x, 1, 10},
 Ticks → {Range[0, 10]}, PlotLegends → "Expressions"]
```

Out[56]=




In[57]:=
```
nodes = {-1, 0, 1, 2};
values = {5, 1, 1, 11};
LagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

Out[59]=
$$-\frac{5}{6}(1-x)(2-x)x + \frac{1}{2}(1-x)(2-x)(1+x) + \frac{1}{2}(2-x)x(1+x) + \frac{11}{6}(-1+x)x(1+x)$$

In[60]:=
```
Simplify[-5/6 (1 - x) (2 - x) x + 1/2 (1 - x) (2 - x) (1 + x) + 1/2 (2 - x) x (1 + x) + 11/6 (-1 + x) x (1 + x)]
```

Out[60]=
$$1 - 3\,x + 2\,x^2 + x^3$$

In[61]:=
```
LagrangePolynomial[1.5]
```

Out[61]=
```
4.375
```