PRACTICAL-9

Lagrange Interpolation Polynomial

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```
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's values are not of same size"];
   Return[];];
  For[i = 1, i ≤ n, i++,
   L[i, x_] = (Product[(x - xi[[j]]) / (xi[[i]] - xi[[j]]), {j, 1, i - 1}]) *
      (Product[(x - xi[[j]]) / (xi[[i]] - xi[[j]]), {j, i + 1, n}]);];
  polynomial[x_] = Sum[L[k, x] * fi[[k]], {k, 1, n}];
  Return[polynomial[x]];]
```

Ques-1

```
nodes = {0, 1, 3};
values = {1, 3, 55};
lagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

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

```
Expand[%]
```

$$1-6x+8x^2$$

Ques-2

```
nodes = {0, 1, 3};
values = {1, 3};
lagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

```
List of points and function's values are not of same size
```

Ques-3

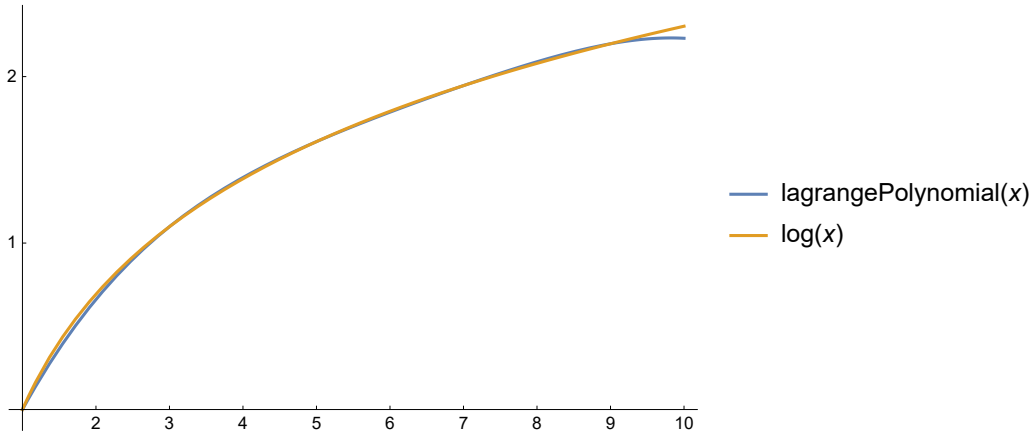
```
nodes = {1, 3, 5, 7, 9};
values = {N[Log[1]], N[Log[3]], N[Log[5]], N[Log[7]], N[Log[9]]};
lagrangePolynomial[x_] = LagrangePolynomial[nodes, values]
```

$$0. + 0.0114439\,(5 - x)\,(7 - x)\,(9 - x)\,(-1 + x) + 0.0251475\,(7 - x)\,(9 - x)\,(-3 + x)\,(-1 + x) + 0.0202699\,(9 - x)\,(-5 + x)\,(-3 + x)\,(-1 + x) + 0.00572194\,(-7 + x)\,(-5 + x)\,(-3 + x)\,(-1 + x)$$

```
Simplify[%]
```

$$-0.987583 + 1.18991\,x - 0.223608\,x^2 + 0.0221231\,x^3 - 0.000844369\,x^4$$

```
Plot[{lagrangePolynomial[x], Log[x]}, {x, 1, 10},
 Ticks → {Range[0, 10]}, PlotLegends -> "Expressions"]
```



Ques-4

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

$$-\frac{5}{6}(1 - x)(2 - x)\,x + \frac{1}{2}(1 - x)(2 - x)(1 + x) + \frac{1}{2}(2 - x)\,x\,(1 + x) + \frac{11}{6}(-1 + x)\,x\,(1 + x)$$

```
Simplify[%]
```

$$1 - 3\,x + 2\,x^2 + x^3$$

```
lagrangePolynomial[1.5]
```

```
4.375
```