Practical 9 : - Lagrange Interpolation

Find the approximated polynomial using Lagrange Interpolation.

Q1 : Data = {(-1, 5), (0, 1), (1, 1), (2, 11)}

```
Clear["Global*`"];
n = 4;
Array[x, n];
x[1] = -1;
x[2] = 0;
x[3] = 1;
x[4] = 2;
Array[y, n];
y[1] = 5;
y[2] = 1;
y[3] = 1;
y[4] = 11;
poly[t_] :=
 Simplify[Sum[Product[If[k ≠ i, (t - x[k])/(x[i] - x[k]), 1], {k, 1, 4}] * y[i], {i, 1, 4}]]
```

In[ ]:= `poly[x]`

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

In[ ]:= `For[i = -1, i ≤ 2, ++i, Print["x = ", i, " y = ", poly[i]]]`

```
x = -1 y = 5
x = 0 y = 1
x = 1 y = 1
x = 2 y = 11
```

Q2 : Data = {(-3,-23), (1, -11), (2, -23), (5, 1)}

In[ ]:=
```
Clear["Global*`"];
n = 4;
Array[x, n];
x[1] = -3;
x[2] = 1;
x[3] = 2;
x[4] = 5;
Array[y, n];
y[1] = -23;
y[2] = -11;
y[3] = -23;
y[4] = 1;
poly[t_] :=
 Simplify[Sum[Product[If[k ≠ i, (t - x[k])/(x[i] - x[k]), 1], {k, 1, 4}] * y[i], {i, 1, 4}]]
```

$$\text{Simplify}\left[\text{Sum}\left[\text{Product}\left[\text{If}\left[k \neq i, \frac{(t - x[k])}{(x[i] - x[k])}, 1\right], \{k, 1, 4\}\right] * y[i], \{i, 1, 4\}\right]\right]$$

In[ ]:=
```
poly[x]
```

Out[ ]= $1 - 10\,x - 3\,x^2 + x^3$

In[ ]:=
```
For[i = 1, i ≤ 4, ++i, Print["x = ", x[i], " y = ", poly[x[i]]]]
```

```
x = -3 y = -23
x = 1 y = -11
x = 2 y = -23
x = 5 y = 1
```

Q3 : Data = {(-2,39),(-1,3),(0,-1),(1,-3),(2,-9),(3,-1)}

In[322]:=
```
ClearAll;
n = 6;
Array[x, n];
x[1] = -2;
x[2] = -1;
x[3] = 0;
x[4] = 1;
x[5] = 2;
x[6] = 3;
Array[y, n];
y[1] = 39;
y[2] = 3;
y[3] = -1;
y[4] = -3;
y[5] = -9;
y[6] = -1;
Array[l, n];
For[i = 1, i ≤ 6, ++i,
 prod = 1;
 For[k = 1, k ≤ 6, ++k,
  If[k == i, Continue[]];
  prod = prod * (t - x[k]) / (x[i] - x[k])
 ];
 l[i] = prod;
]
sum = 0;
For[i = 1, i ≤ 6, ++i,
 sum = sum + l[i] * y[i];
]
Print["Interpolated Polynomial ", Simplify[sum]];
```

Interpolated Polynomial $-1 - 3 t^3 + t^4$

In[345]:=
```
Inpoly[t_] := -1 - 3 t^3 + t^4;
```

In[347]:=
```
For[i = 1, i ≤ 6, ++i, Print["x = ", x[i], " y = ", Inpoly[x[i]]]]
```

```
x = -2 y = 39

x = -1 y = 3

x = 0 y = -1

x = 1 y = -3

x = 2 y = -9

x = 3 y = -1
```