Робилко Т . М . 221701 Лабораторная Работа 3 - Интерполяция и среднеквадратичное приближение

```
f[x_] = (Sinh[Sqrt[x^2 + x + 5]] + π) / Sqrt[3 x^8 + 11 x^4 + 33]; (* Вариант 10 *)
```

$$f[x\_] = \frac{\mathrm{Sinh}\left[\sqrt{x^2 + x + 5}\right] + \pi}{\sqrt{3 x^8 + 11 x^4 + 33}};\ (*\ \text{Вариант 10}\ *)$$

Задание 1 (n = 6)

In[ ]:=

```
A = 0;
B = 6;
n = 6;
H = B/n;
data = N[Table[{i H, f[i H]}, {i, 0, n}]];
Grid[data, Frame → All]
```

Out[ ]=

0.	1.35195
1.	1.48099
2.	0.540904
3.	0.236911
4.	0.173183
5.	0.173726
6.	0.212533

In[ ]:=

```
dataX = data[[All, 1]];
dataY = data[[All, 2]];
```

In[ ]:=

```
LagrangeInterpolation[dataX_, dataY_, n_] :=
  Sum[dataY[[i]] * Product[If[i ≠ j, (x - dataX[[j]]) / (dataX[[i]] - dataX[[j]]), 1], {j, 1, n}], {i, 1, n}];
```

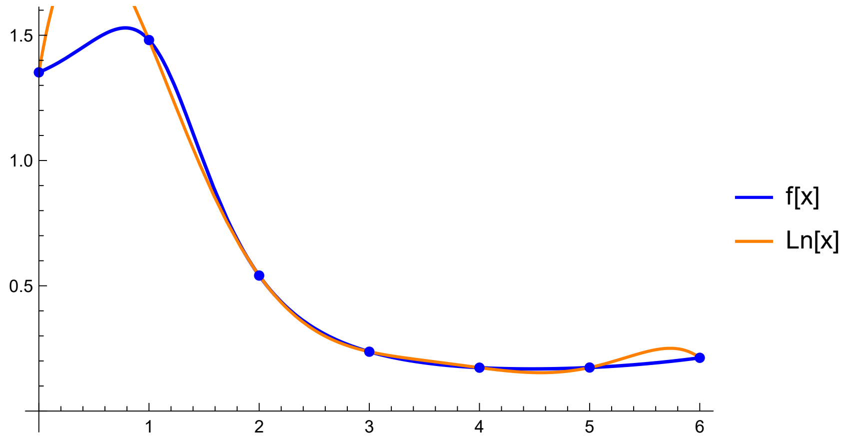
$$\sum_{i=1}^{n} dataY[[i]] * \prod_{j=1}^{n} If[i \neq j,\ (x - dataX[[j]]) / (dataX[[i]] - dataX[[j]]),\ 1];$$

In[ ]:=
```
Ln = LagrangeInterpolation[dataX, dataY, n + 1] // Simplify;
Print["Ln(x) =", Ln];
```

Ln(x) =1.35195 + 2.61987 x − 4.22694 x^2 + 2.23346 x^3 − 0.563182 x^4 + 0.0691465 x^5 − 0.00332041 x^6

In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Ln, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Ln[x]"}]]
```

Out[ ]=



In[ ]:=
```
Array[dif, {n + 1, n + 1}, {0, 0}];
For[k = 1, k ≤ n, k++,
      For[i = n, i ≥ n - k, i--, dif[i, k] = 0]];
For[i = 0, i ≤ n, i++, dif[i, 0] = data[[i + 1, 2]]];
For[k = 1, k ≤ n, k++,
  For[i = 0, i ≤ n - k, i++,
   dif[i, k] = dif[i + 1, k - 1] - dif[i, k - 1]]];
tableData = Array[dif, {n + 1, n + 1}, {0, 0}];
Grid[tableData, Frame → All]
```

Out[ ]=

1.35195	0.129032	−1.06911	1.7052	−2.10103	2.32086	−2.39069
1.48099	−0.940083	0.63609	−0.395824	0.219828	−0.0698367	0
0.540904	−0.303993	0.240266	−0.175996	0.149991	0	0
0.236911	−0.0637272	0.0642698	−0.0260053	0	0	0
0.173183	0.000542657	0.0382646	0	0	0	0
0.173726	0.0388072	0	0	0	0	0
0.212533	0	0	0	0	0	0

In[ ]:=

NewtonInterpolationMultiplier[dataX_, n_, i_, H_] := $\dfrac{\prod_{k=1}^{i}\left(\frac{x-\text{dataX}[[n]]}{H}+k-1\right)}{i!}$

NewtonInterpolationSecondMethod[dataX_, dataY_, deltaTable_, H_, n_] :=

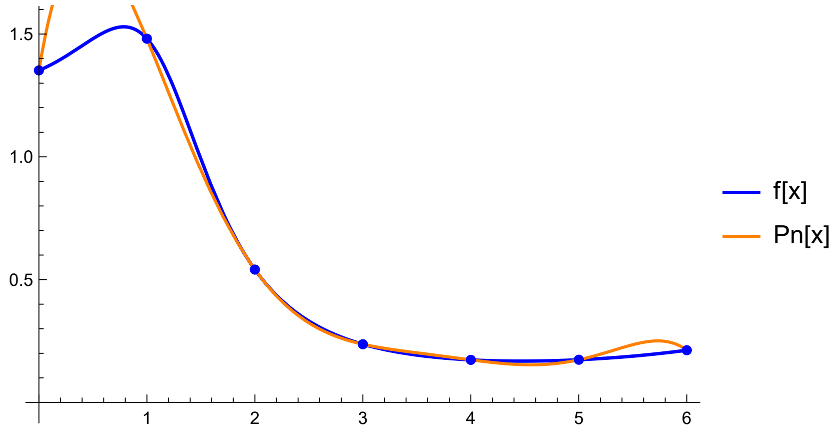
dataY[[n]] + $\sum_{i=1}^{n-1}$ (NewtonInterpolationMultiplier[dataX, n, i, H] * deltaTable[[n - i, i + 1]]);

```
In[ ]:= Pn = NewtonInterpolationSecondMethod[dataX, dataY, tableData, H, n + 1] // Simplify;
        Print["Pn(x) =" Newton];
```

Pn(x) = $(1.35195 + 2.61987\,x - 4.22694\,x^2 + 2.23346\,x^3 - 0.563182\,x^4 + 0.0691465\,x^5 - 0.00332041\,x^6)$

```
In[ ]:= func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
        func2 = Plot[Pn, {x, A, B}, PlotStyle → Orange];
        dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
        Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Pn[x]"}]]
```

Out[ ]=

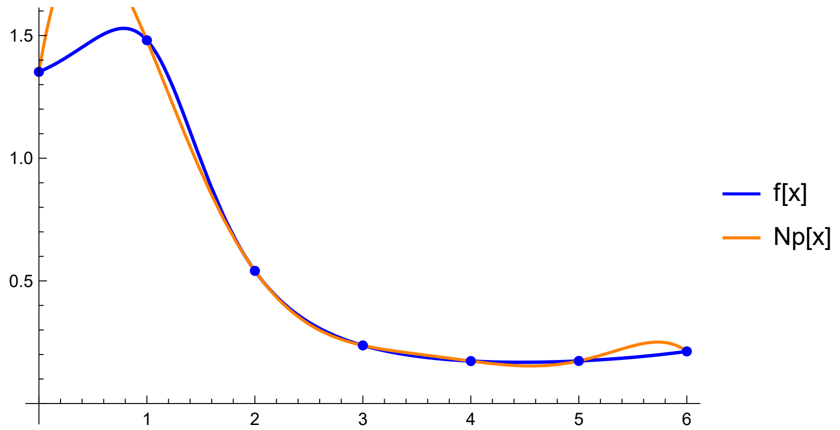



```
In[ ]:= Np = InterpolatingPolynomial[data, x];
        Np = Simplify[Np];
        Print["Np(x) =", Np];
```

Np(x) =$1.35195 + 2.61987\,x - 4.22694\,x^2 + 2.23346\,x^3 - 0.563182\,x^4 + 0.0691465\,x^5 - 0.00332041\,x^6$

```
In[ ]:= func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
        func2 = Plot[Np, {x, A, B}, PlotStyle → Orange];
        dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
        Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Np[x]"}]]
```

Out[ ]=



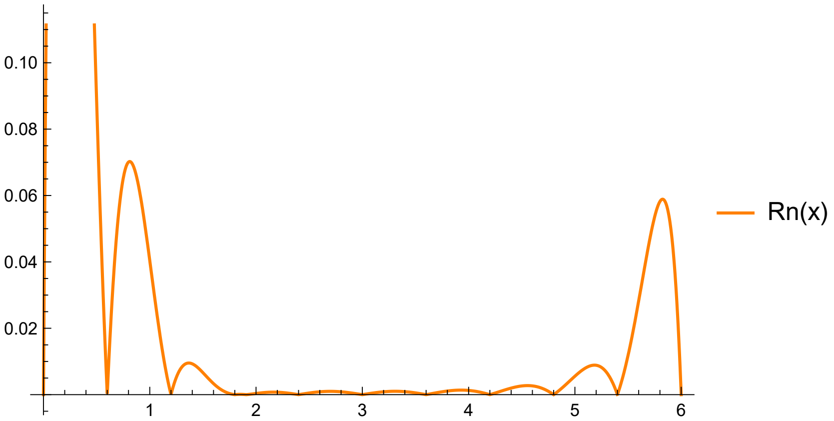

```
In[ ]:= Print["f[2.4316]= ", f[2.4316]];
        Print["Ln[2.4316]= ", Ln /. x → 2.4316];
        Print["Pn[2.4316]= ", Pn /. x → 2.4316];
        Print["Np[2.4316]= ", Np /. x → 2.4316];
```

```
f[2.4316] = 0.350875

Ln[2.4316] = 0.343952

Pn[2.4316] = 0.343952

Np[2.4316] = 0.343952
```

In[∘]:=
```
Rn = Abs[f[x] - Np];
```

In[∘]:=
```
func1 = Plot[Rn, {x, 0, 6}, PlotStyle → Orange];
Legended[Show[func1], LineLegend[{Orange}, {"Rn(x)"}]]
```

Out[∘]=




```
FindMaximum[{Rn, A ≤ x ≤ B}, x] (* Тут задание 1 E *)
```

Out[∘]=
```
{0.402046, {x → 0.372543}}
```

Задание 1 (n = 10)

In[∘]:=
```
n = 10;
H = B/n;
data = N[Table[{i H, f[i H]}, {i, 0, n}]];
Grid[data, Frame → All]
```

Out[∘]=

0.	1.35195
0.6	1.50591
1.2	1.33212
1.8	0.685663
2.4	0.360695
3.	0.236911
3.6	0.187258
4.2	0.169776
4.8	0.170404
5.4	0.184714
6.	0.212533

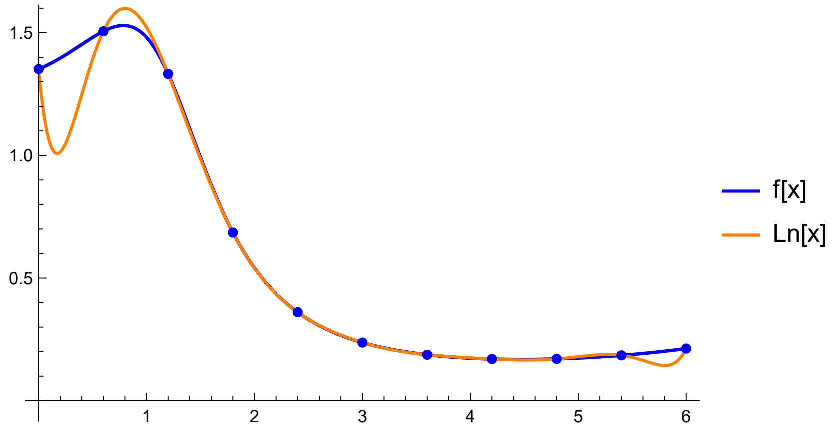
In[∘]:=
```
dataX = data[[All, 1]];
dataY = data[[All, 2]];
```

In[ ]:=
```
Ln = LagrangeInterpolation[dataX, dataY, n + 1] // Simplify;
Print["Ln(x) =", Ln];
```

Ln(x) =$1.35195 - 4.76894\,x + 21.1867\,x^2 - 34.0133\,x^3 + 27.9651\,x^4 - 13.7075\,x^5 + 4.2577\,x^6 - 0.84853\,x^7 + 0.105364\,x^8 - 0.00742946\,x^9 + 0.000227331\,x^{10}$

In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Ln, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Ln[x]"}]]
```

Out[ ]=



In[ ]:=
```
Array[dif, {n + 1, n + 1}, {0, 0}];
For[k = 1, k ≤ n, k++, For[i = n, i ≥ n - k, i--, dif[i, k] = "0"]];
For[i = 0, i ≤ n, i++, dif[i, 0] = data[[i + 1, 2]]];
For[k = 1, k ≤ n, k++, For[i = 0, i ≤ n - k, i++,
   dif[i, k] = dif[i + 1, k - 1] - dif[i, k - 1]]];
tableData = Array[dif, {n + 1, n + 1}, {0, 0}];
Grid[tableData, Frame → All]
```

Out[ ]=

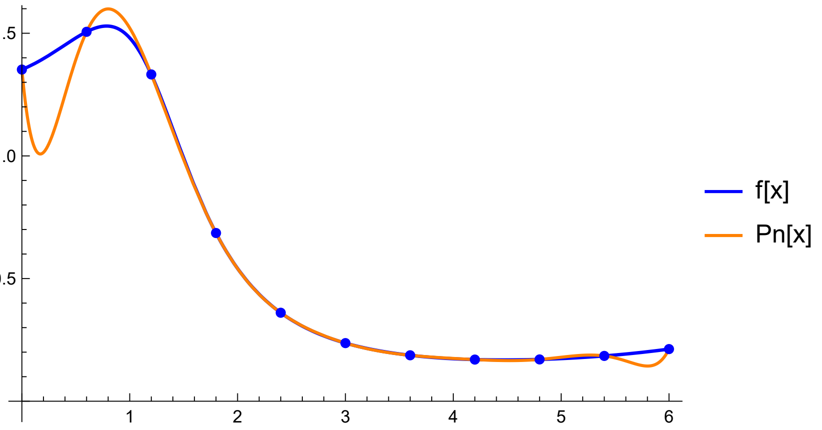
1.35195	0.153951	-0.327734	-0.144945	0.939116	-1.8536	2.76133	-3.57724	4.24413	-4.72309	4.98809
1.50591	-0.173782	-0.472678	0.794171	-0.91448	0.907738	-0.815906	0.666889	-0.478957	0.265007	0
1.33212	-0.646461	0.321493	-0.120309	-0.00674231	0.0918314	-0.149017	0.187932	-0.21395	0	0
0.685663	-0.324968	0.201184	-0.127051	0.0850891	-0.057186	0.0389142	-0.0260184	0	0	0
0.360695	-0.123784	0.0741321	-0.0419624	0.027903	-0.0182718	0.0128958	0	0	0	0
0.236911	-0.0496523	0.0321697	-0.0140594	0.00963124	-0.00537599	0	0	0	0	0
0.187258	-0.0174825	0.0181104	-0.00442811	0.00425525	0	0	0	0	0	0
0.169776	0.000627854	0.0136823	-0.000172862	0	0	0	0	0	0	0
0.170404	0.0143101	0.0135094	0	0	0	0	0	0	0	0
0.184714	0.0278195	0	0	0	0	0	0	0	0	0
0.212533	0	0	0	0	0	0	0	0	0	0

In[ ]:=
```
Pn = NewtonInterpolationSecondMethod[dataX, dataY, tableData, H, n + 1] // Simplify;
Print["Pn(x) =", Pn];
```

Pn(x) =$1.35195 - 4.76894 x + 21.1867 x^2 - 34.0133 x^3 + 27.9651 x^4 - 13.7075 x^5 + 4.2577 x^6 - 0.84853 x^7 + 0.105364 x^8 - 0.00742946 x^9 + 0.000227331 x^{10}$

In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Pn, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Pn[x]"}]]
```

Out[ ]=

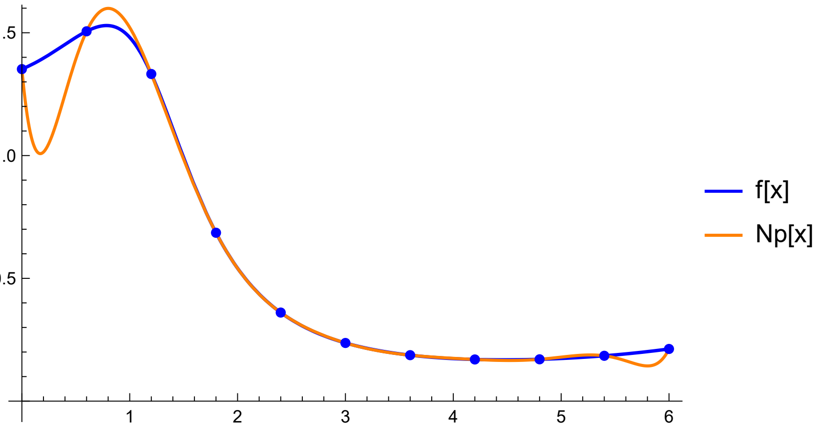


In[ ]:=
```
Np = InterpolatingPolynomial[data, x];
Np = Simplify[Np];
Print["Np(x)=", Np];
```

Np(x) =$1.35195 - 4.76894\, x + 21.1867\, x^2 - 34.0133\, x^3 + 27.9651\, x^4 - 13.7075\, x^5 + 4.2577\, x^6 - 0.84853\, x^7 + 0.105364\, x^8 - 0.00742946\, x^9 + 0.000227331\, x^{10}$

In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Np, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Np[x]"}]]
```

Out[ ]=



In[ ]:=
```
Print["f[2.4316]= ", f[2.4316]];
Print[ "Ln[2.4316]= ", Ln /. x → 2.4316];
Print[ "Pn[2.4316]= ", Pn /. x → 2.4316];
Print["Np[2.4316]= ", Np /. x → 2.4316];
```

f[2.4316]= 0.350875

Ln[2.4316]= 0.351038

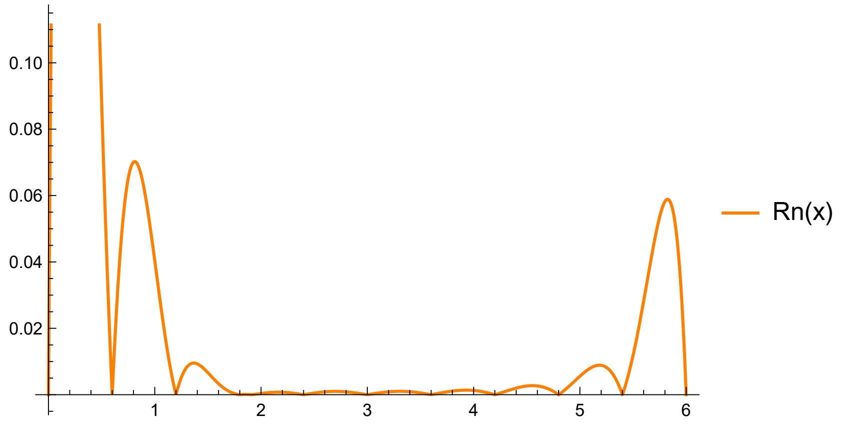
Pn[2.4316]= 0.351038

Np[2.4316]= 0.351038

In[ ]:=
```
Rn = Abs[f[x] - Np];
```

In[ ]:=
```
func1 = Plot[Rn, {x, 0, 6}, PlotStyle → Orange];
Legended[Show[func1], LineLegend[{Orange}, {"Rn(x)"}]]
```

Out[ ]=



In[ ]:=
```
FindMaximum[{Rn, A ≤ x ≤ B}, {x, 0}]
```

Out[ ]=
```
{0.383245, {x → 0.187989}}
```

Задание 2 (n = 6)

In[ ]:=
```
n = 6;
```

In[ ]:=
$$\text{For}\left[i = 0,\ i \le n,\ i{+}{+},\ t_i = \text{Cos}\left[\frac{(\text{Pi} * (2 * i + 1))}{2 * n + 2}\right];\ x_i = \frac{(A + B)}{2} + \frac{(B - A)}{2} * t_i;\right]$$

In[ ]:=
```
data = N[Table[{x_i, f[x_i]}, {i, 0, n}]];
dataX = data[[All, 1]];
dataY = data[[All, 2]];
Grid[data, Frame → All]
```

Out[ ]=

5.92478	0.208242
5.34549	0.182875
4.30165	0.168805
3.	0.236911
1.69835	0.777439
0.654506	1.5168
0.0752163	1.36691

In[ ]:=
$$\text{DividedDifferenceRecursive}[\text{dataX\_},\ \text{dataY\_},\ \text{begin\_},\ \text{end\_}] := \text{If}\left[\text{begin} + 1 == \text{end},\ \frac{(\text{dataY}[[\text{end}]] - \text{dataY}[[\text{begin}]])}{\text{dataX}[[\text{end}]] - \text{dataX}[[\text{begin}]]},\ (\text{DividedDifferenceRecursive}[\text{dataX},\ \text{dataY},\ \text{begin} + 1,\ \text{end}] - \text{DividedDifferenceRecursive}[\text{dataX},\ \text{dataY},\ \text{begin},\ \text{end} - 1])\ /\ (\text{dataX}[[\text{end}]] - \text{dataX}[[\text{begin}]])\right]$$

In[∘]:=
```
Array[dif, {n + 1, n + 1}, {0, 0}];
For[k = 1, k ≤ n, k++,      For[i = n, i ≥ n - k, i--, dif[i, k] = "0"]];
For[i = 0, i ≤ n, i++, dif[i, 0] = data⟦i + 1, 2⟧];
For[k = 1, k ≤ n, k++, For[i = 0, i ≤ n - k, i++,
   dif[i, k] = DividedDifferenceRecursive[dataX, dataY, i + 1, k + i + 1]]];
tableData = Array[dif, {n + 1, n + 1}, {0, 0}];
Grid[tableData, Frame → All]
```

Out[∘]=

0.208242	0.0437901	0.0186745	-0.00320707	0.00646566	0.00262241	-0.00117389
0.182875	0.0134789	0.0280544	-0.0305338	-0.00735518	0.00948917	0
0.168805	-0.0523226	0.139416	0.0039693	-0.0573657	0	0
0.236911	-0.415264	0.124939	0.246422	0	0	0
0.777439	-0.708307	-0.595792	0	0	0	0
1.5168	0.258742	0	0	0	0	0
1.36691	0	0	0	0	0	0

In[∘]:=
```
differenceResult = Table[dif[i, k], {i, 0, n}, {k, 1, n}];
```

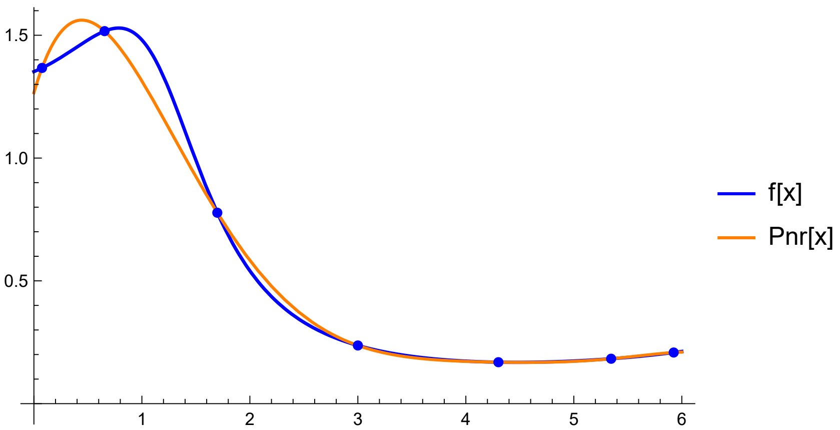
In[∘]:=
$$\text{NewtonDivDiff[dataX\_, dataY\_, n\_, diff\_]} := \text{dataY⟦1⟧} + \sum_{i=1}^{n} \text{diff⟦1, i⟧} * \prod_{k=1}^{i} (x - \text{dataX⟦k⟧})$$

In[∘]:=
```
Pnr = NewtonDivDiff[dataX, dataY, n, differenceResult] // Simplify;
Print["Pnr(x) =", Pnr];
```

Pnr(x) =$1.26612 + 1.51061\, x - 2.34974\, x^2 + 1.10896\, x^3 - 0.24822\, x^4 + 0.0271858\, x^5 - 0.00117389\, x^6$

In[∘]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Pnr, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Pnr[x]"}]]
```

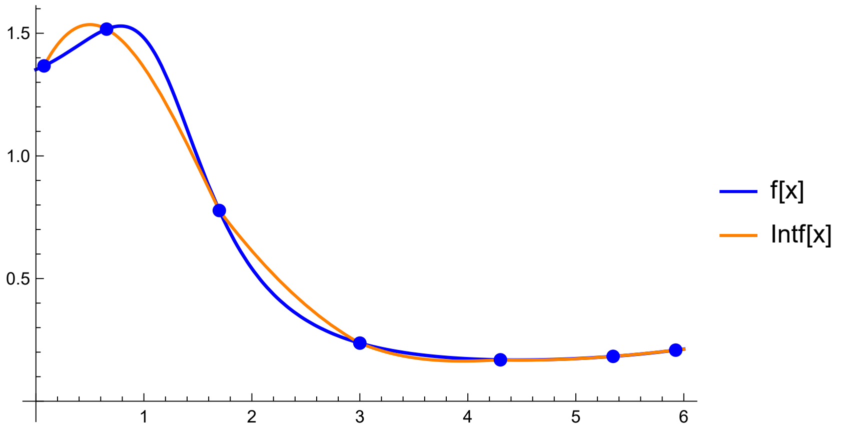
Out[∘]=



In[∘]:=
```
Intf = Interpolation[data];
```

In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Intf[x], {x, dataX[[n + 1]], B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Intf[x]"}]]
```

Out[ ]=



In[ ]:=
```
Print["f[2.4316]= ", f[2.4316]];
Print[ "Pnr[2.4316]= ", Pnr /. x → 2.4316];
Print["Intf[2.4316]= ", Intf[2.4316]];
```

```
f[2.4316]= 0.350875

Pnr[2.4316]= 0.380613

Intf[2.4316]= 0.417935
```

In[ ]:=
```
AbsPnr[x_] := Abs[f[x] - Pnr];
FindMaximum[{AbsPnr[x], A ≤ x ≤ B}, x]
```

Out[ ]=
```
{0.113657, {x → 0.330325}}
```

In[ ]:=
```
AbsIntf[x_] := Abs[f[x] - Intf[x]];
FindMaximum[{AbsIntf[x], A ≤ x ≤ B}, x]
```

Out[ ]=
```
{0.0779474, {x → 0.338156}}
```

Задание 2 (n = 10)

In[ ]:=
```
n = 10;
```

In[ ]:=

For$\Big[$i = 0, i ≤ n, i++,

$$t_i = \mathrm{Cos}\left[\frac{(\mathrm{Pi} * (2 * i + 1))}{2 * n + 2}\right];\ x_i = \frac{(A + B)}{2} + \frac{(B - A)}{2} * t_i\Big]$$

In[ ]:=
```
data = N[Table[{xᵢ, f[xᵢ]}, {i, 0, n}]];
dataX = data⟦All, 1⟧;
dataY = data⟦All, 2⟧;
Grid[data, Frame → All]
```

Out[ ]=

5.96946	0.210762
5.7289	0.198185
5.26725	0.180425
4.62192	0.168696
3.8452	0.177356
3.	0.236911
2.1548	0.456838
1.37808	1.13487
0.732751	1.5271
0.271104	1.41546
0.0305357	1.35776

In[ ]:=
```
Array[dif, {n + 1, n + 1}, {0, 0}];
For[k = 1, k ≤ n, k++, For[i = n, i ≥ n - k, i--, dif[i, k] = "0"]];
For[i = 0, i ≤ n, i++, dif[i, 0] = data[[i + 1, 2]]];
For[k = 1, k ≤ n, k++, For[i = 0, i ≤ n - k, i++,
   dif[i, k] = DividedDifferenceRecursive[dataX, dataY, i + 1, k + i + 1]]];
tableData = Array[dif, {n + 1, n + 1}, {0, 0}];
Grid[tableData, Frame → All]
```

Out[ ]=

0.210762	0.0522787	0.0196623	0.000984804	0.00103476	-0.000369922	0.000303657	-0.0000649449	-0.000370011	-0.000272437	-0.0000850628
0.198185	0.0384715	0.0183353	-0.0012133	0.00213323	-0.00152827	0.000601844	0.0018727	0.00118243	0.000232745	0
0.180425	0.0181748	0.0206208	-0.00703466	0.00759542	-0.00414679	-0.00875442	-0.00458079	-0.000143828	0	0
0.168696	-0.011149	0.0365701	-0.030675	0.023723	0.0355501	0.0141319	-0.0038276	0	0	0
0.177356	-0.0704628	0.112249	-0.107629	-0.114537	-0.025935	0.0317059	0	0	0	0
0.236911	-0.260208	0.377782	0.248863	-0.0218431	-0.146882	0	0	0	0	0
0.456838	-0.872941	-0.186452	0.308471	0.414318	0	0	0	0	0	0
1.13487	-0.607797	-0.767518	-0.571652	0	0	0	0	0	0	0
1.5271	0.241825	0.00280749	0	0	0	0	0	0	0	0
1.41546	0.239853	0	0	0	0	0	0	0	0	0
1.35776	0	0	0	0	0	0	0	0	0	0

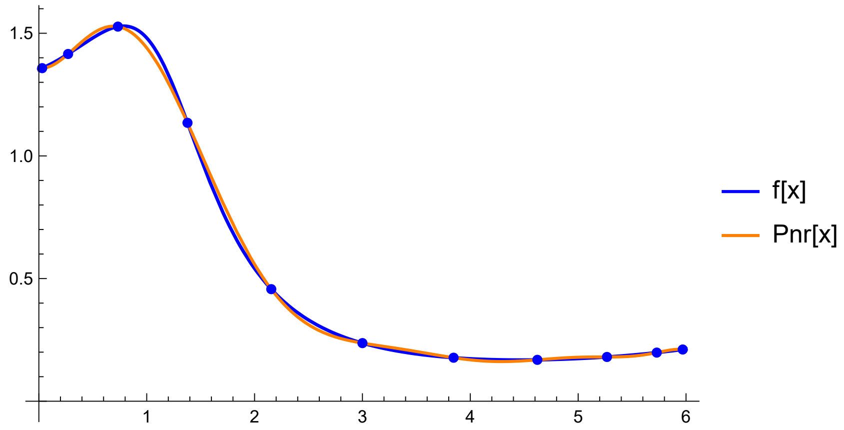
In[ ]:=
```
differenceResult = Table[dif[i, k], {i, 0, n}, {k, 1, n}];
```

In[ ]:=
```
Pnr = NewtonDivDiff[dataX, dataY, n, differenceResult] // Simplify;
Print["Pnr(x)=", Pnr];
```

Pnr(x) $=1.35877 - 0.0759415\, x + 1.45207\, x^2 - 1.34812\, x^3 - 0.82115\, x^4 + 1.46293\, x^5 - 0.766402\, x^6 + 0.207231\, x^7 - 0.0313769\, x^8 + 0.00253204\, x^9 - 0.0000850628\, x^{10}$

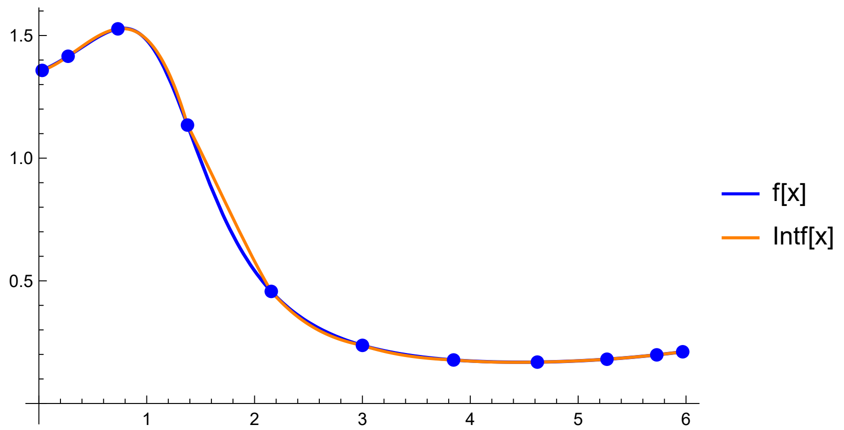
In[ ]:=
```
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Pnr, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.015], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Pnr[x]"}]]
```

Out[ ]=



In[ ]:=
```
Intf = Interpolation[data];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Intf[x], {x, dataX⟦n + 1⟧, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Intf[x]"}]]
```

Out[ ]=



In[ ]:=
```
Print["f[2.4316]= ", f[2.4316]];
Print["Pnr[2.4316]= ", Pnr /. x → 2.4316];
Print[ "Intf[2.4316]= ", Intf[2.4316]];
```

```
f[2.4316]= 0.350875

Pnr[2.4316]= 0.332651

Intf[2.4316]= 0.343216
```

In[ ]:=
```
AbsPnr[x_] := Abs[f[x] - Pnr];
FindMaximum[{AbsPnr[x], A ≤ x ≤ B}, {x, 0.1}]
```

Out[ ]=
```
{0.00890886, {x → 0.134523}}
```

In[ ]:=
```
AbsIntf[x_] := Abs[f[x] - Intf[x]];
FindMaximum[{AbsIntf[x], dataX⟦n + 1⟧ ≤ x ≤ dataX⟦1⟧}, {x, 3.4}]
```

Вывод : Как показали результаты, увеличение количества узлов позволяет уменьшить погрешность интерполирования. При этом неравномерное распределение узлов (оптимальный выбор их расположения) по отрезку позволяет уменьшить погрешность, в частности вблизи крайних участков отрезка.

Задание 4

Out[∘]=

```
{0.00350652, {x → 3.38986}}
```

In[∘]:=

```
n = 10;
H = B/n;
data = N[Table[{i H, f[i H]}, {i, 0, n}]];
Grid[data, Frame → All]
```

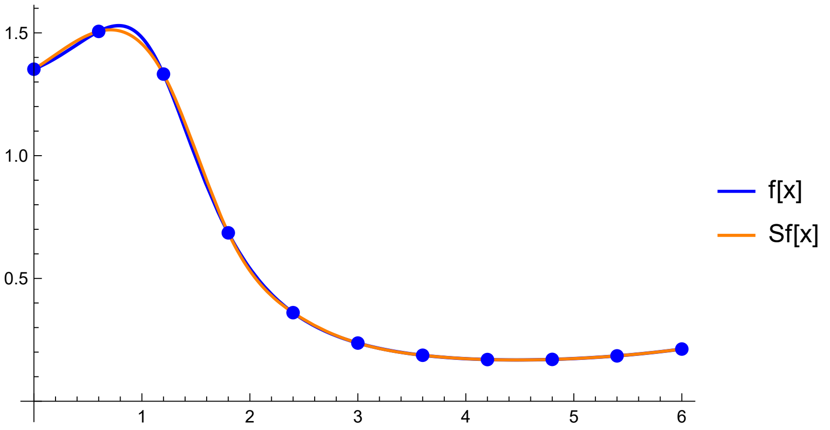
Out[∘]=

0.	1.35195
0.6	1.50591
1.2	1.33212
1.8	0.685663
2.4	0.360695
3.	0.236911
3.6	0.187258
4.2	0.169776
4.8	0.170404
5.4	0.184714
6.	0.212533

In[∘]:=

```
Sf = Interpolation[data, Method → "Spline"];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Sf[x], {x, dataX[[n + 1]], B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Sf[x]"}]]
```

Out[∘]=



In[∘]:=

```
Print["f[2.4316]= ", f[2.4316]];
Print["Sf[2.4316]= ", Sf[2.4316]];
```

```
f[2.4316] = 0.350875

Sf[2.4316] = 0.351566
```

Задание 5

In[∘]:=
```
n = 10;
B = 6;
H = B/n;
data = N[Table[{i H, f[i H]}, {i, 0, n}]];
dataX = data[[All, 1]];
dataY = data[[All, 2]];
Grid[data, Frame → All]
```

Out[∘]=

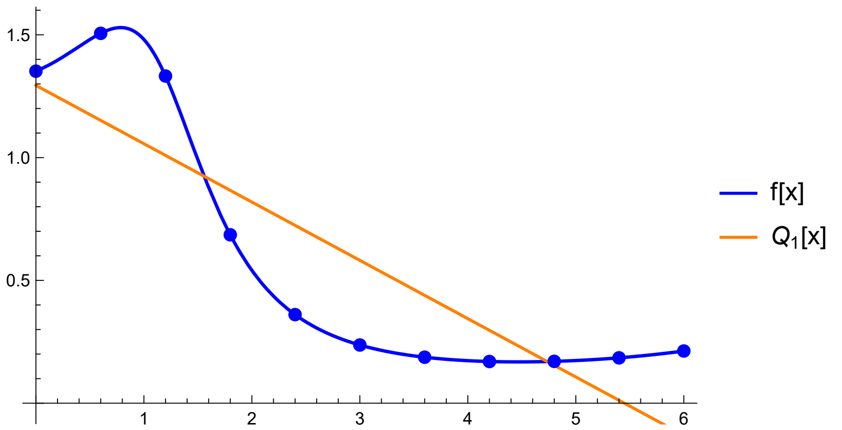
0.	1.35195
0.6	1.50591
1.2	1.33212
1.8	0.685663
2.4	0.360695
3.	0.236911
3.6	0.187258
4.2	0.169776
4.8	0.170404
5.4	0.184714
6.	0.212533

In[ ]:=

```
result =
  LinearSolve[Table[Table[If[i + k == 0, Sum[1, {j, 1, n+1}], Sum[dataX[[j]]^(i+k), {j, 1, n+1}]], {i, 0, 1}], {k, 0, 1}],
   Table[If[i == 0, Sum[dataY[[j]], {j, 1, n+1}], Sum[(dataY[[j]] * dataX[[j]]^i), {j, 1, n+1}]], {i, 0, 1}]];
polinomialResult = 0;
m = 1;
k = 0;
While[k ≤ m, polinomialResult = polinomialResult + result[[k + 1]] * x^k;
  k++];
Q1 = polinomialResult;
Print["Q1(x)=", Q1];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Q1, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Q1[x]"}]]
```

$Q_1(x)$ =1.29401 − 0.237458 x

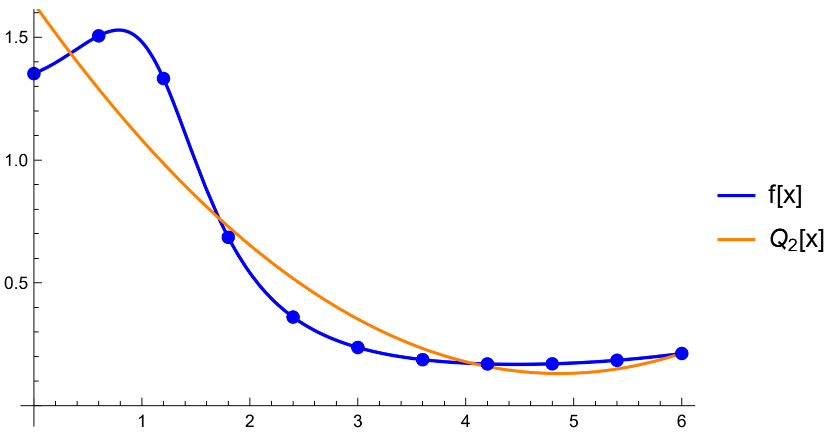
Out[ ]=



In[ ]:=
```
result =
  LinearSolve[Table[Table[If[i + k == 0, Sum[1, {j, 1, n+1}], Sum[dataX[[j]]^(i+k), {j, 1, n+1}]], {i, 0, 2}], {k, 0, 2}],
   Table[If[i == 0, Sum[dataY[[j]], {j, 1, n+1}], Sum[(dataY[[j]] * dataX[[j]]^i), {j, 1, n+1}]], {i, 0, 2}]];
polinomialResult = 0;
m = 2;
k = 0;
While[k ≤ m, polinomialResult = polinomialResult + result[[k + 1]] * x^k;
  k++];
Q2 = polinomialResult;
Print["Q2(x)=", Q2];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Q2, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Q2[x]"}]]
```

$Q_2(x) = 1.63798 - 0.619649\,x + 0.0636985\,x^2$

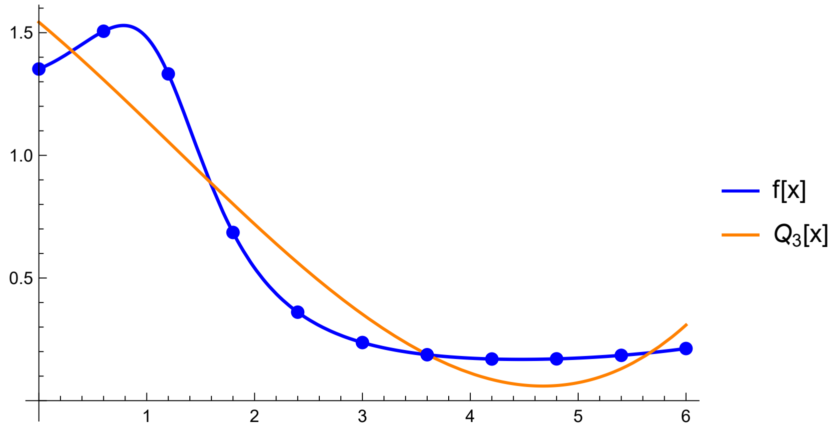
Out[ ]=



In[ ]:=
```
Q3 = Fit[data, {1, x, x^2, x^3}, x];
Print["Q3(x)=", Q3];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Q3, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Q3[x]"}]]
```

$Q_3(x) = 1.5429 - 0.367874\,x - 0.0463432\,x^2 + 0.0122269\,x^3$

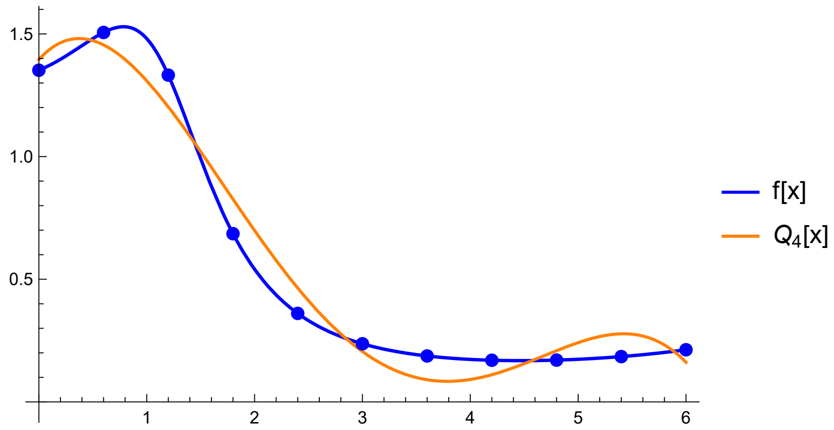
Out[ ]=



In[ ]:=
```
Q4 = Fit[data, {1, x, x^2, x^3, x^4}, x];
Print["Q4(x)=", Q4];
func1 = Plot[f[x], {x, A, B}, PlotStyle → {Blue, Thickness[0.005]}];
func2 = Plot[Q4, {x, A, B}, PlotStyle → Orange];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func1, func2, dots], LineLegend[{Blue, Orange}, {"f[x]", "Q4[x]"}]]
```

$Q_4(x) = 1.39575 + 0.483684\,x - 0.755975\,x^2 + 0.201462\,x^3 - 0.0157696\,x^4$

Out[ ]=



In[ ]:=

```
func1 = Plot[Q₁, {x, A, B}, PlotStyle → Orange];
func2 = Plot[Q₂, {x, A, B}, PlotStyle → Red];
func3 = Plot[Q₃, {x, A, B}, PlotStyle → Gray];
func4 = Plot[Q₄, {x, A, B}, PlotStyle → {Blue, Thickness[0.008]}];
dots = ListPlot[data, PlotStyle → {PointSize[0.02], Blue}];
Legended[Show[func2, func1, func3, func4, dots],
 LineLegend[{Orange, Red, Gray, Blue}, {"Q₁[x]", "Q₂[x]", "Q₃[x]", "Q₄[x]"}]]
```

Out[ ]=