Horner’s Diagram

Software Documentation

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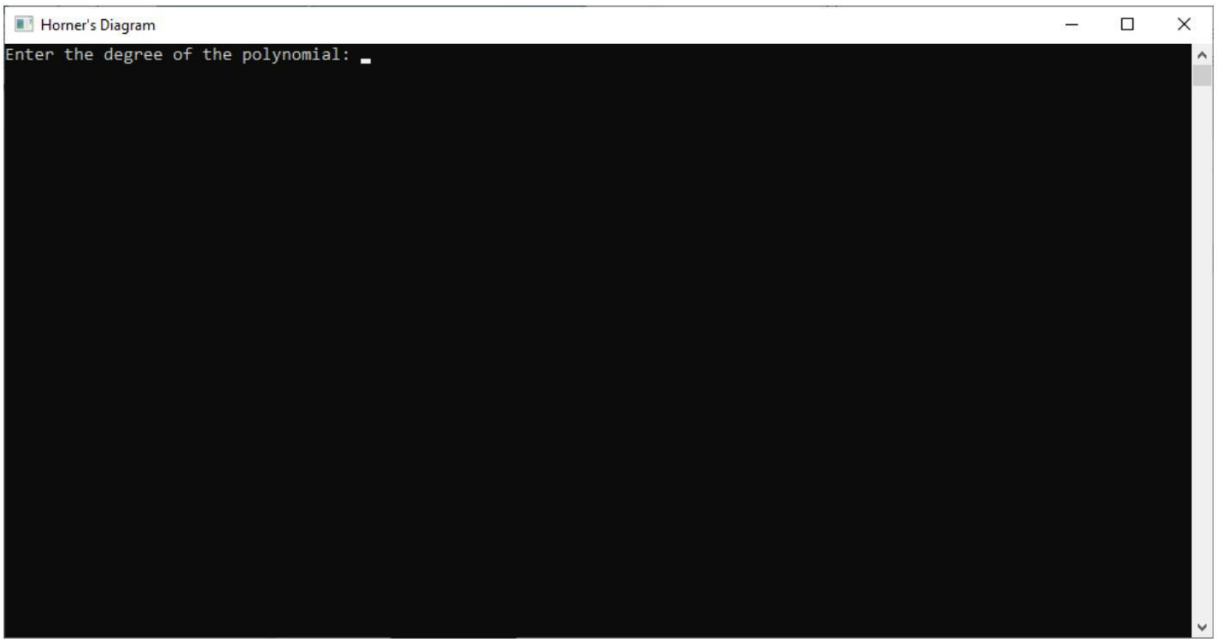
Introduction

This software documentation includes: description of the application's operation, what is needed for use, algorithms used, interface description and source code description. This application is used to determine the value of a polynomial using Horner's scheme.

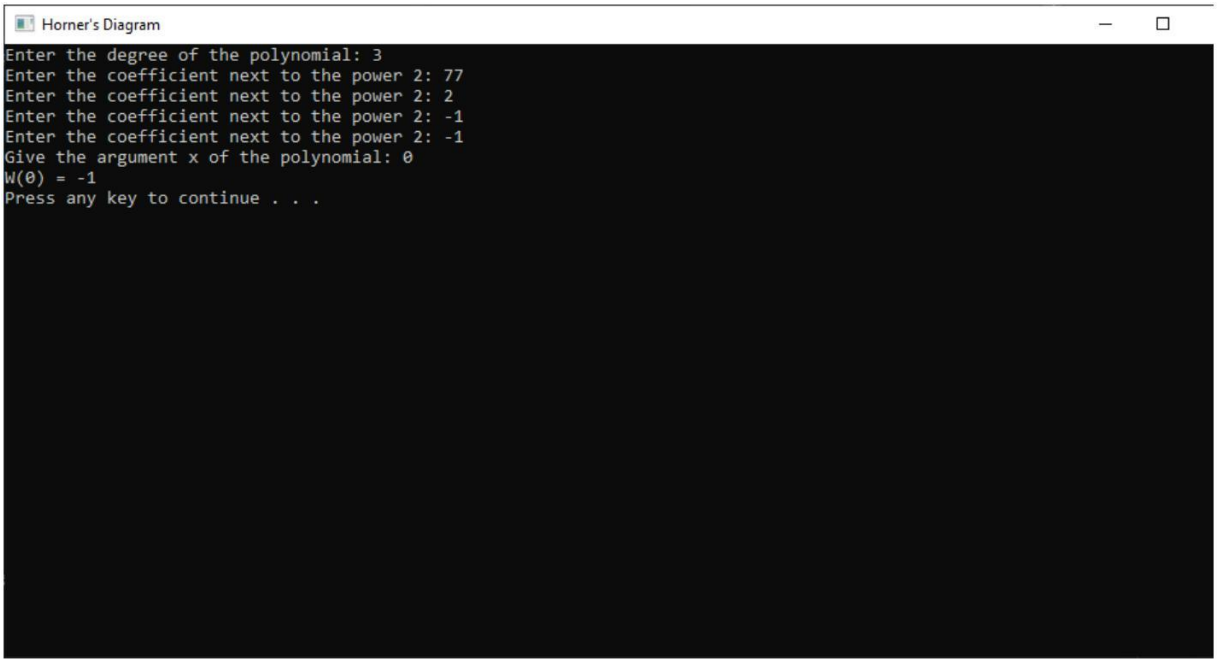
Describing of the application’s operation

If the user wants to sort any non-empty set of numbers, run the *.exe file. After this operation, the console window will appear on the screen as below.



Drawing 1: The beginning of the application's operation [own study]

First, the user enters the degree of the polynomial. Then he gives the coefficients of the power sequentially from left to right. After confirming each one, he gives the argument x. The end result is the result of the polynomial W (x).



Drawing 2: The effect of the program [own study]

What is needed for use?

The application does not require installation. It only needs the Windows operating system.

Algorithms used

The algorithm used in the application is based on the Horner diagram.

Horner's scheme is an algorithm for very fast calculation of a polynomial value. It reduces the number of multiplications to a minimum. Let's analyze the following polynomial:

$$W(x) = 3x^3 + 3x^2 - 2x + 11$$

To determine the value of a polynomial using the traditional method, 6 multiplications should be made:

$$W(x) = 3 \cdot x \cdot x \cdot x + 3 \cdot x \cdot x - 2 \cdot x + 11$$

With the Horner scheme of these multiplications, only 3 should be performed:

$$W(x) = 3 \cdot x^3 + 3x^2 - 2x + 11 = x \cdot (3 \cdot x^2 + 3x - 2) + 11 = x \cdot (x \cdot (3 \cdot x + 3) - 2) + 11$$

so we have:

$$W(x) = x \cdot (x \cdot (3 \cdot x + 3) - 2) + 11$$

For an nth degree polynomial, usually the following number of multiplications (including factors) should be made:

$$n + (n - 1) + (n - 2) + \ldots + 2 + 1 = n \cdot (n + 1)\ 2$$

(sum of the arithmetic sequence), while for the discussed method only n multiplications. As shown in the example (1) first we'll start doing the action inside the parentheses:

$$3 \cdot x + 3$$

Then we multiply by the value of the argument x, then we subtract 2 and multiply by x again. We repeat the steps until we calculate the value of the whole polynomial.

The input data will be the coefficients of the polynomial and its degree. Then we give the argument for which we want to find the value of the polynomial. Note that a polynomial with n degree has n + 1 factors.[1]

Interface description

The interface is a console pane. The operation of the program is based on user communication. He gives the needed values on the input. The course of the process and possible operating errors are described in the chapter „Describing of the application's operation".

Source code description

The project was made in the C++ programming language, in the Dev-C++ programming environment. All work was done on the Windows 10 operating system. The application's source code looks like this.

```
#include<iostream>
#include<windows.h>
using namespace std;

int horner(int wsp[],int st, int x){
     if(st==0) return wsp[0];
     return x*horner(wsp,st-1,x)+wsp[st];
}

int main(){
     SetConsoleTitleA("Horner's Diagram");

     int *coefficients;
     int degree, x;

     cout<<"Enter the degree of the polynomial: ";
     cin>>degree;
     coefficients=new int[degree+1];
     for(int i=0;i<=degree;i++){
          cout<<"Enter the coefficient next to the power "<<degree-
1<<": ";
          cin>>coefficients[i];
```

```
	}
	cout<<"Give the argument x of the polynomial: ";
	cin>>x;
	cout<<"W("<<x<<") = "<<horner(coefficients,degree,x)<<endl;
	delete []coefficients;
	system("pause");
	return 0;
}
```

Listing 1: Source code [own study]

List of drawings

List of listings

Bibliography

[1] http://www.algorytm.edu.pl/algorytmy-maturalne/schemat-hornera.html