Lagrange Interpolation

Due Time: 5/2/2021 at 11:59 PM **Earnings:** 6% of your final grade

NOTE: Plan to finish a few days early to avoid last minute hardware/software or other unexpected holdups, for which no allowance is given.
NOTE: The code in this assignment must be your own work. It must not be code taken from another student or written for you by someone else, even if you give a reference to the person you got it from (attribution); if it is not entirely your own work it will be treated as plagiarism and given a fail mark, or less.

Problem Description:

Use Lagrange interpolation to interpolate the following functions:

(a) $f(x) = \sqrt{1 + x^2}$

(b) $f(x) = \frac{1}{1+25x^2}$

using a set of n+1 regularly spaced nodes computed by the following equation:

$$x_k = -1 + \frac{2(k-1)}{n}, k = 1,2,3, \dots \dots, n+1$$

Test your generated polynomial with different orders, n= **5, 10, 20** and compute the interpolation polynomial $P_n(x)$ at 41 regularly spaced points.

For each value of x_k the Lagrange polynomial approximation is output together with the exact /true value from the math library, also output the absolute error.

What to Submit: Set up an empty project in Visual Studio 2019 with the name ass1. add a new source code file ass1.cpp\c to the project and write your code in it to implement the application, as described above.
Then on Brightspace in the Assignment Submission folder submit your ass1.cpp\c file.

Don't submit the project, submit only .c or .cpp file.

There is a late penalty of 25% per day - even one minute is counted late.
You may lose 60% or more if:

- The output is wrong
- Your program won't build in Visual Studio 2019
- Your program crashes in normal operation
- I can't build it because you submitted the wrong files or the files are missing, even if it's an honest mistake – this gets 100% deduction.

Don't send me the file as an email attachment – it will get 0.

It is also vital that you should follow the **Submission Standard** in your source file so it can be identified as yours.

Make sure you have submitted the correct file. If I cannot build it because the file is wrong even if it's an honest mistake, you get 0.

Example Output:

```
        Lagrange interpolation
MENU
 1. Function A
 2. Function B
 3. Quit

Enter your choice: 1

WHEN n=5
```

K	Xk	P	TRUE VALUE	ABSOLUTE ERROR
0	-1.0000000	1.4142140	1.414213562	4.38E-07
1	-0.9500000	1.3802810	1.379311422	9.70E-04
2	-0.9000000	1.3468090	1.345362405	1.45E-03
3	-0.8500000	1.3139990	1.312440475	1.56E-03
4	-0.8000000	1.2820420	1.280624847	1.42E-03
5	-0.7500000	1.2511190	1.25	1.12E-03
6	-0.7000000	1.2213990	1.220655562	7.43E-04
7	-0.6500000	1.1930400	1.192686044	3.54E-04
8	-0.6000000	1.1661900	1.166190379	3.79E-07
9	-0.5500000	1.1409860	1.141271221	2.85E-04
10	-0.5000000	1.1175530	1.118033989	4.81E-04
11	-0.4500000	1.0960050	1.09658561	5.81E-04
12	-0.4000000	1.0764470	1.077032961	5.86E-04
13	-0.3500000	1.0589710	1.059481005	5.10E-04
14	-0.3000000	1.0436600	1.044030651	3.71E-04
15	-0.2500000	1.0305840	1.030776406	1.92E-04
16	-0.2000000	1.0198040	1.019803903	9.73E-08

17	-0.1500000	1.0113680	1.011187421	1.81E-04
18	-0.1000000	1.0053150	1.004987562	3.27E-04
19	-0.0500000	1.0016730	1.00124922	4.24E-04
20	0.0000000	1.0004570	1	4.57E-04
21	0.0500000	1.0016730	1.00124922	4.24E-04
22	0.1000000	1.0053150	1.004987562	3.27E-04
23	0.1500000	1.0113680	1.011187421	1.81E-04
24	0.2000000	1.0198040	1.019803903	9.73E-08
25	0.2500000	1.0305840	1.030776406	1.92E-04
26	0.3000000	1.0436600	1.044030651	3.71E-04
27	0.3500000	1.0589710	1.059481005	5.10E-04
28	0.4000000	1.0764470	1.077032961	5.86E-04
29	0.4500000	1.0960050	1.09658561	5.81E-04
30	0.5000000	1.1175530	1.118033989	4.81E-04
31	0.5500000	1.1409860	1.141271221	2.85E-04
32	0.6000000	1.1661900	1.166190379	3.79E-07
33	0.6500000	1.1930400	1.192686044	3.54E-04
34	0.7000000	1.2213990	1.220655562	7.43E-04
35	0.7500000	1.2511190	1.25	1.12E-03
36	0.8000000	1.2820420	1.280624847	1.42E-03
37	0.8500000	1.3139990	1.312440475	1.56E-03
38	0.9000000	1.3468090	1.345362405	1.45E-03
39	0.9500000	1.3802810	1.379311422	9.70E-04
40	1.0000000	1.4142140	1.414213562	4.38E-07

```
WHEN n=10

……display 41 column table ……


WHEN n=15

.....……display 41 column table ……


MENU
 1. Function A
 2. Function B
 3. Quit

Enter your choice: 2
WHEN n=5


……display 41 column table ……

WHEN n=10
```

```
……display 41 column table ……


WHEN n=15

……display 41 column table ……


MENU
 1. Function A
 2. Function B
 3. Quit
Enter your choice: 3

Exit
```