Moore's Law

Due Time: 23.59, Sun 17 March 2019 **Earnings:** 9% 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.

Purpose: Fit data using linear regression least squares method for an exponential function.
Algorithm. Write a program named ass2 that will enable the user to fit file data to an exponential function.

Here is a table of transistor counts for CPUs over the years,. It is in a file on Brightspace named *moore.txt* with the format: CPU name, year after 1970 (subtracting 1970 increases the accuracy of the fit), transistor count. Here is the actual data:

CPU Name	Year t	transistor count N
4004	1971	2300
8008	1972	2500
8080	1974	4500
8086	1978	29000
80286	1982	134000
80386	1985	275000
80486	1989	1200000
Pentium	1993	3100000
PentiumII	1997	7500000
PentiumIII	1999	9500000
Pentium4	2000	4200000
Itanium	2001	025000000
Itanium2	2002	220000000
Itanium2(9MBcache)	2004	592000000

Moore's Law is an empirical observation that the transistor count increases exponentially with time. You will verify this behaviour by doing a least-squares fit to the exponential function. For the data in the file the function has the form $N = ae^{b(t-1970)}$ where a and b are constants that are determined from the fit.
Until the user wishes to quit the application:

- *read data from a file*
- *do an exponential fit*
- *offer an interpolation/extrapolation of both the transistor count and the rate of increase of transistor count*

Fit to $N = ae^{b(t-1970)}$.
You are fitting the data to the exponential growth law $N = ae^{b(t-1970)}$ where N represents the transistor count and t represents the year and a and b are constants. The formulas in class notes are fits to the straight line equation y = mx + c so the exponential data has to be transformed to have this linear relation as discussed in class notes. With the transformed data solve the least-squares linear regression formulas as in the lecture notes to get solutions for m and c and then convert them back to a and b. Then using the exponential formula with a and b offer the user the option of interpolating/ extrapolating the data to find what the transistor count and rate of increase will be in other years.

Set up a empty project in Visual Studio 2017 with the name ass2. In a file named ass2.cpp using the C (or/C++) programming language, write the code to implement the application, as described above,. Example output is given at the end. Yours should be the same. Note than your assignment might be tested with different interpolation/extrapolation parameters than those shown.

See the Marking Sheet for how you can lose marks, but you will lose at least 60% if:
1. it fails to build and run in Visual Studio 2017
2. It crashes in normal operation
3. it doesn't produce the example output.

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

What to Do: Make an empty project in Visual Studio 2017, add a new source code file ass2.cpp to the project and write your code in it. Then on Brightspace in the Assignment Submission folder submit a zip file (**not** RAR, not 9zip, not 7 zip) containing your ass2.cpp. The name of the zip file **must** contain your name as a prefix so that I can identify it, for example using my name the file would be tyleraAss2CST8233.zip. It is also vital that you include the Information (as specified in the Submission Standard) as a file header in your source file so it can be identified as yours. Use comment lines in the file to include the header.
There is a late penalty of 25% per day. Don't send me the file as an email attachment – it will get 0.

Example Output:

```
        LEAST_SQUARES LINEAR REGRESSION
MENU
 1. Exponential Fit
 2. Quit
1
Please enter the name of the file to open: moore.txt
year            tranCount               Name
1971            2.300e+03               4004
1972            2.500e+03               8008
1974            4.500e+03               8080
1978            2.900e+04               8086
1982            1.340e+05               80286
1985            2.750e+05               80386
1989            1.200e+06               80486
1993            3.100e+06               Pentium
1997            7.500e+06               PentiumII
1999            9.500e+06               PentiumIII
2000            4.200e+07               Pentium4
2001            2.500e+07               Itanium
2002            2.200e+08               Itanium2
2004            5.920e+08               Itanium2(9MBcache)

There are 14 records.

Linear Regression Fit:  transistor count = 1.439e+03*exp(3.431e-01*(year-1970))

MENU
 1. Extrapolation
 2. Main Menu
 1
Please enter the year to extrapolate to: 2020
Year = 2020
transistor count = 4.063e+10
rate of count increase = 1.394e+10 transistors/year

MENU
 1. Extrapolation
 2. Main Menu
 1
Please enter the year to extrapolate to: 2025
Year = 2025
transistor count = 2.259e+11
rate of count increase = 7.751e+10 transistors/year

MENU
 1. Extrapolation
 2. Main Menu
 2

        LEAST_SQUARES LINEAR REGRESSION
MENU
 1. Exponential Fit
 2. Quit
```