CST 8233 – F19 - Assignment #2

# Moore's Law

**Due Time:** 23:59, 8 November 2019

**Earnings:** 10% of your final grade

***NOTE: Plan to finish a few days early to avoid last minute hardware/software 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.

**Discussion:** Moore's Law is an empirical observation that shows that the transistor count increases exponentially with time. You will verify this behaviour by doing a least-squares fit to the 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 | 42000000 |
| Itanium | 2001 | 25000000 |
| Itanium2 | 2002 | 220000000 |
| Itanium2(9MBcache) | 2004 | 592000000 |

For the data in the file, the function has the form $N = a \times e^{b(t-1970)}$ where $a$ and $b$ are constants that are determined from the fit. Until the user wishes to quit the application should do the following:

- Read data from a file
- Do an exponential fit
- Offer an interpolation/extrapolation of both the transistor count and its rate of increase

**Fit to $\boldsymbol{N = a \times e^{b(t-1970)}}$:** You are fitting the data to the exponential growth law $N = a \times e^{b(t-1970)}$ where $N$ represents the transistor count and $t$ represents the year and $a$ and $b$ are constants. The basic formulas are fits to the straight line equation $y = mx + c$, so the exponential data has to be transformed to have this linear relation. With the transformed data solve the least-squares linear regression formulas 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.

**What to Submit:** Use Brightspace to submit this assignment as a zip file (**not** RAR, not 9zip, not 7 zip) containing only the source code file (ass2.cpp). The name of the zipped folder **must** contain your name as a prefix so that I can identify it, for example using my name the file would be kadriaAss1CST8233.zip. It is also vital that you include the file header (as specified in the Submission Standard) so the file can be identified as yours. Use comment lines in the file to include the header.

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 application won't build in Visual Studio 2019
- Your application 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.

***Example Output***

Example output is given below. Yours should be the same. Note than your assignment might be tested with different interpolation / extrapolation parameters than those shown.

```
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
```