##### Moore’s Law (Least Squares Linear Regression Fit)

**Due Time:** 23.59, 20 March 2016 **Earnings:** 9% of your final grade

***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.***

|  |  |
| --- | --- |
| The graph on the right shows microprocessor transistor counts for various CPUs over the time period 1971 – 2011. The data falls roughly on a straight line when plotted with a logarithmic transistor count (y-axis) and a linear time (x-axis). Such behavior is suggestive of an exponential relationship:  y = a\*exp(c\*x)  where a and c are constants to be determined from a linear regression fit (see below).  The exponential relation is known as Moore’s Law. | C:\Algonquin\W16\CST8233\Assignments\ass2\Transistor_Count_and_Moore's_Law_-_2011_svg.png |

Data for some CPUs is in the file *moore.txt* that you will use for the assignment. This is a file of transistor counts for CPUs over the years, measured from 1970 as time zero. The file has the format: CPU name, year from 1970 as zero, transistor count.

Your starting point for the linear regression is a transform that linearizes the data so you can then use the formulas from the course book. To do this for the general equation y=aecx do a transform by taking the natural log of both sides:

log(y) = log(a) + log(ecx) = log(a) + cx

Then re-label the terms as Y = log(y), X = x, b = log(a), m = c to give the linearized equation:

Y = mX + b

which is now in the form of a straight line that you fit using the linear least-squares formulas for m and b from the book and finally get back the original constants a and c you want from a = eb and c = m.

#### In summary, to get the data in the form for which you can use the linear regression formulas, read in the data from the file and save the x values (time) as X unchanged but take the natural log of the y values (transistor count) and save them in a new array named Y. Then apply the linear regression formulas to X and Y.

#### Derivative

Now that you have the coefficients a and c, the formula y = a\*exp(c\*x) can be evaluated for any x (time) to give the transistor count (y). However also note that it is straightforward to differentiate this formula to get the derivative (rate of count increase per year) of the transistor count. This is

dy/dx = c\*a\*exp(c\*x)

#### Algorithm

The source file of data for the assignment is *moore.txt* (note that the assignment should work for any file of data for which the number of entries is unknown to the user). The data is then fit to an exponential as described above to get the constants a and c for

transistor count = a\*exp(c\*time)

The user can then choose to do an interpolation/extrapolation of either the transistor count, or the rate of increase of transistor count from

rate of increase of transistor count = c\*a\*exp(c\*time)

The example output at the end shows how your application must work.

**What to Submit :** Use Blackboard to submit this assignment as a zipped file containing the source code file(s) (ass2.cpp) done as C or C++. 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 tyleraAss2CST8233.zip. It is also vital that you include the Cover Information as specified in the Submission Standard as a file header in your source files so the files can be identified as yours. Use comment lines in the files to include the header.

Before you submit the code, check that it builds and executes in Visual Studio 2013 as you expect - if it doesn’t build for me, for whatever reason, you get a deduction of at least 60%. There is a late penalty of 25% per day. Do not send me the file as an email attachment – it will get 0.

**Example output**

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**Exponential fit by Linear Regression**

**1. Read Data from File**

**2. Quit**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Select an option: 1**

**please enter the name of the file to open:moore.txt**

**FILE OPENED FOR READING**

**There are 13 records.**

**NAME YEAR COUNT**

**4004 1971 2300**

**8008 1972 2500**

**8080 1974 4500**

**8086 1978 29000**

**80286 1982 134000**

**80386 1985 275000**

**80486 1989 1.2e+006**

**Pentium 1993 3.1e+006**

**PentiumII 1997 7.5e+006**

**PentiumIII 1999 9.5e+006**

**Pentium4 2000 4.2e+007**

**Itanium 2001 2.5e+007**

**Itanium2 2002 2.2e+008**

**File read into memory**

**EXPONENTIAL FUNCTION**

**Fit data to exponential: y = a\*exp(c\*x)**

**EXPONENTIAL: y = 1634.06\*exp(0.330625\*x)**

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**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of transistor count**

**2. Interpolation/Extrapolation of rate of increase of transistor count**

**3. Quit Interpolation/Extrapolation**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Select an option: 1**

**Interpolation/Extrapolation of transistor count**

**Please enter the year(e.g. 2005) : 2020**

**transistor count at 2020 = 2.47004e+010**

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**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of transistor count**

**2. Interpolation/Extrapolation of rate of increase of transistor count**

**3. Quit Interpolation/Extrapolation**

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**Select an option: 2**

**2. Interpolation/Extrapolation of rate of increase of transistor count**

**Please enter the year(e.g. 2005) : 2020**

**rate of increase at 2020 = 8.16658e+009 per year**

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**Eponential Interpolation/Extrapolation**

**1. Interpolation/Extrapolation of transistor count**

**2. Interpolation/Extrapolation of rate of increase of transistor count**

**3. Quit Interpolation/Extrapolation**

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**Select an option: 3**

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**Exponential fit by Linear Regression**

**1. Read Data from File**

**2. Quit**

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

**Select an option: 2**

**Press any key to continue . . .**