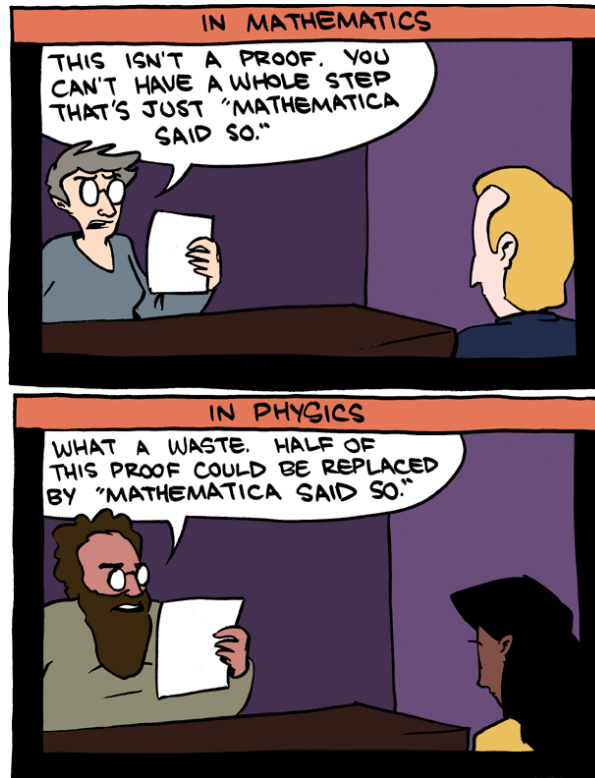# MATH 162-005 MATHEMATICA LAB I

SPRING 2020

This cartoon is drawn from Saturday Morning Breakfast Cereal.

Lab report due: **31 January 2020**

You may work with other students, but you must submit your own lab report. At the top of the lab, please list any and all people (other than the instructor) who assisted you. If several people are submitting exactly the same results (especially identical errors), their scores may be reduced accordingly.

You must submit your lab as a stapled hard copy. You may use free-form input. Do not use calculators when Mathematica is far more powerful than any calculator yet conceived. When you need help, please see our student assistant or me.

You have the option of downloading Mathematica 12 on your laptop (for free) or else using Loyola's network.

Watch the video Hands On Start.

Submit a *printed version* of your Mathematica notebook. On your front page (using *Mathematica*) state your name and "Mathematica Lab I" using an appropriate style, font, size and color in Mathematica.

Number each problem and *restate the problem* before giving the solution.

1. Which is larger?: e^π or π^e Explain why?   (*Hint:* Consider the difference of the two numbers.)

2. Express $1.23^{4.567}$ correct to 13 significant digits.

3. Using the **FactorInteger** command, find the *prime decomposition* of   1234567890

4. Using the **Simplify** command, simplify the expression

$$\frac{1}{(a-b)(a-c)} + \frac{1}{(b-c)(b-a)} + \frac{1}{(c-a)(c-b)}$$

(*Hint: Be careful of the syntax when you enter this quantity.*)

5. Find the *largest prime factor* of $n = 88^9 + 74^4 + 1$

6. A *Mersenne* prime is defined to be a prime number of the form $2^n - 1$.   Using basic algebra, it is easy to show that if $2^n - 1$ is prime, then *n* must be prime as well.   In 1644, in the preface to his book, *Cogitata Physica-Mathematica*, Mersenne asserted that $2^n - 1$ is prime for n = 2, 3, 5, 7, 13, 17, 19, 31, 67, 127.   Was Mersenne correct?   Explain. *(Give a convincing argument!)*

(*Hint: Be careful!*)
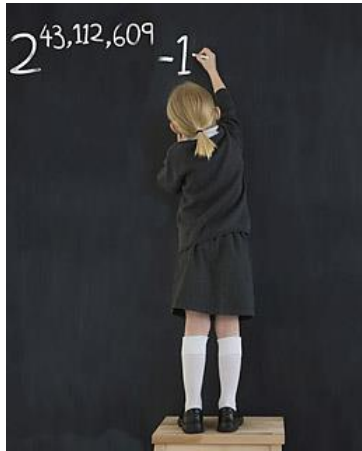
The 46th Mersenne prime found in 2008.

(chosen by Time Magazine as one of the "50 best inventions of 2008")

7. Which is larger: 75!   or 29^{75}?   Why? *(Give a convincing argument!) Hint: You may wish to consider the quotient rather than the difference.)*

8. Using the **Expand** command, simplify fully the expression

$$(a + b - c)^3 - (a - b - c)^3$$

9. Simplify $\left(1 + \sqrt{11}\right)^8 - \left(1 - \sqrt{11}\right)^8$

10. Simplify the algebraic expression $\dfrac{1}{x - \dfrac{1}{x + \frac{1}{x}}} - \dfrac{1}{x + \dfrac{1}{x - \frac{1}{x}}}$

11. Solve the quartic equation $x^4 - 8x^3 + 10x^2 + 24x + 5 = 0$ using

    (a) the Solve command

    (b) the NSolve command

    (c) the FindRoot command

How do these three results differ, if at all?

"If you don't know where you are going, any road will get you there."

\- Lewis Carroll