Homework 1
Introduction to Sage and CoCalc

Many of your homework assignments will require the use of a computer to complete. Some basic skills with mathematical software will be helpful. Sage is one such piece of software that can be used for numerical computations, symbolic computations, creating plots, etc. (Other mathematical packages include Maple, Mathematica, and Matlab.) Sage has many built in functions, and can also be extended by using standard programming techniques. CoCalc is an online workspace that provides a browser interface for doing computations in Sage.

Only part #4 of this assignment is required, and you may complete part #4 using any software package you choose. Parts #1, #2, and #3 will introduce you to Sage and help you set up an account on the CoCalc server.

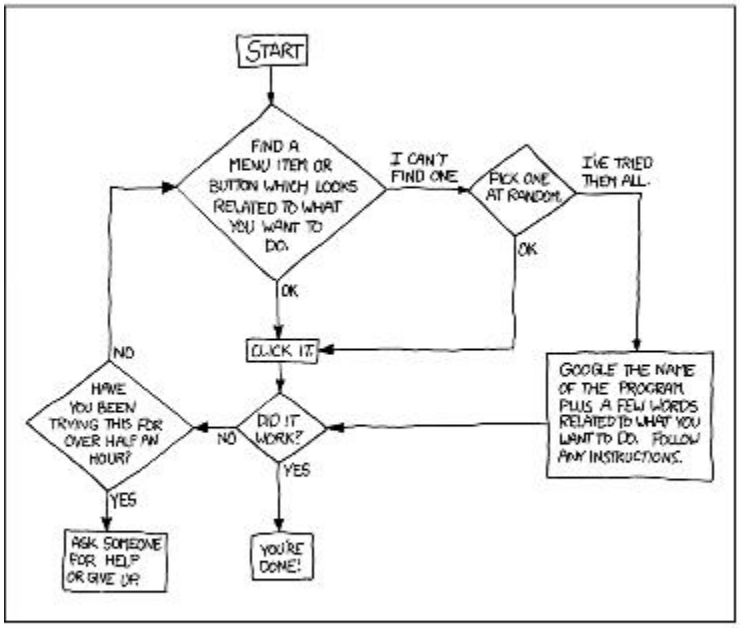
(1) If you are not on campus, log into a VPN so that your computer thinks you are. This can be set up at `vpn.byu.edu`; install the appropriate software and log in with your BYU credentials.
(2) In a web browser, go to `https://mathcrypto.byu.edu`. This will take you to the Cocalc/Sage server for this class. You can create an account or log in using a Google account. If you are asked to select a kernel, choose SageMath.
(3) Look at some of the topics on the webpages
    `http://www.sagemath.org/doc/tutorial/tour.html`
    `http://www.sagemath.org/help.html`.
(4) Create a Sage worksheet in which you do the following. Submit a copy (as a pdf) on Learning Suite.
    (a) Calculate the greatest common divisor of 23456 and 987654.
    (b) Calculate the first 100 digits of π and 2π. One way to do this is to use the `N` command. Another way to do this is to use the command `R=RealField(334)` to create a field R with 334 bits of precision. Then, for example, `R(e)` should give you the number e to 100 decimal places.
    (c) Factor 2233648339787271680000 into primes.
    (d) Find the inverse of the matrix

$$M = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 10 \end{bmatrix}$$

    and multiply it by M to check that this is actually the inverse. In Sage, the command `M=Matrix([[a, b], [c, d]])` will create a 2 by 2 matrix M with entries a, b, c, d. You can use the command `M.inverse()`.
    (e) Find the smallest prime larger than 10^{30}.

DEAR VARIOUS PARENTS, GRANDPARENTS, CO-WORKERS, AND OTHER "NOT COMPUTER PEOPLE."

WE DON'T MAGICALLY KNOW HOW TO DO EVERYTHING IN EVERY PROGRAM. WHEN WE HELP YOU, WE'RE USUALLY JUST DOING THIS:



PLEASE PRINT THIS FLOWCHART OUT AND TAPE IT NEAR YOUR SCREEN. CONGRATULATIONS; YOU'RE NOW THE LOCAL COMPUTER EXPERT!