Homework 1, due September 2
Introduction to Sage

Many of your homework assignments will require the use of a computer to complete. Some basic skill with mathematical software will be very useful. Sage is one example of general purpose mathematical software that can be used for numerical computations, symbolic computations, creating plots, etc. It has many built in functions, but can also be extended by using standard programming techniques. This assignment should help you learn enough about Sage to make future homework assignments less difficult.

If you have not used Sage before, you should complete #1 and #2 and #3 and #4 below; if you have used Sage before, only #4 is required, although completing the others is recommended. If you choose to use other mathematical software (Maple, Mathematica, etc.), complete #4 below using your preferred software.

(1) In a web browser, go to `https://cloud.sagemath.com/`, which is linked at the top of the course webpage. This will take you to a public Sage server. You should be able to create an account or log in using a Google account.
(2) Go to the web site `http://www.sagemath.org/help-video.html` and watch the video "Sage Introduction, Episode 1" there; it is the third video down. Don't worry if you don't understand everything mentioned in the video.
(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:
    (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

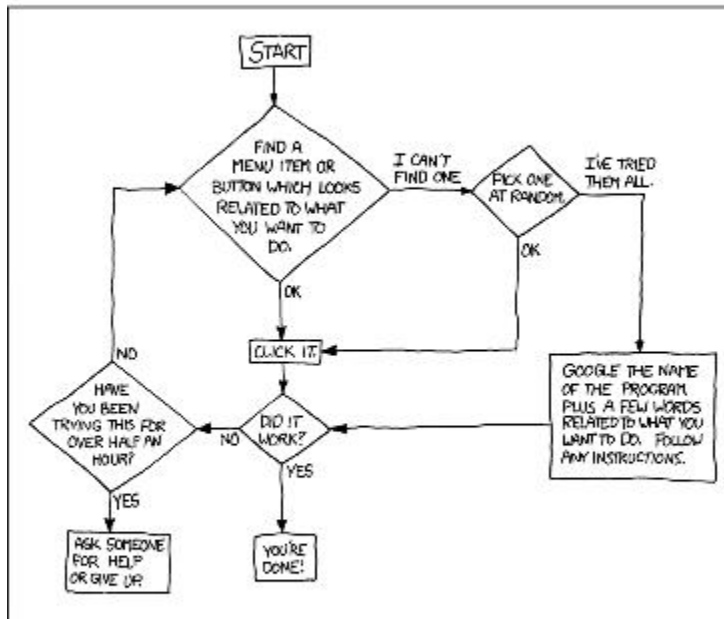$$M = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 10 \end{bmatrix}$$

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}.

Check off each of the items that you completed. Print a copy of your Sage worksheet and attach it to this sheet.

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:

START

FIND A MENU ITEM OR BUTTON WHICH LOOKS RELATED TO WHAT YOU WANT TO DO.

I CAN'T FIND ONE

PICK ONE AT RANDOM.

I'VE TRIED THEM ALL.

OK

OK

CLICK IT.

NO

HAVE YOU BEEN TRYING THIS FOR OVER HALF AN HOUR?

NO

DID IT WORK?

YES

GOOGLE THE NAME OF THE PROGRAM PLUS A FEW WORDS RELATED TO WHAT YOU WANT TO DO. FOLLOW ANY INSTRUCTIONS.

YES

ASK SOMEONE FOR HELP OR GIVE UP.

YOU'RE DONE!

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