

LARSON—MATH 255—CLASSROOM WORKSHEET 27
Files and Interacts.

1. (a) Start the Chrome browser.
(b) Go to `http://cocalc.com`
(c) Login using **your VCU email address** .
(d) Click on our class Project.
(e) Click “New”, then “Worksheets”, then call it **c27**.
(f) For each problem number, label it in the Sage cell where the work is. So for Problem 2, the first line of the cell should be `#Problem 2`.

Interacts

There is a collection of examples of Sage INTERACTS at `http://wiki.sagemath.org/interact/`. Let’s look at a few of these examples to see the kinds of things you can do with Sage.

2. Here is a simple Sage INTERACT with *default* values for a function f to be graphed, and the interval (a, b) that f will be graphed on. The Interact function is named “_”, which is standard—as we will never refer to this function by name.

```
@interact
def _(f=x^2, a=-3, b=3):
    show(plot(f, (x,a,b)))
```

3. Now let’s make this fancy with some *options*.

```
@interact
def _(f=input_box(x^2,width=20),
    axes=True,
    fill=True,
    zoom=range_slider(-3,3,default=(-3,3))):
    show(plot(f, (x,zoom[0], zoom[1]), axes=axes, fill=fill))
```

4. **Prime Numbers.** Try the following Sage Interact which visualizes the Prime Number Theorem (PNT).

```
@interact
def pnt(N=input_box(200)):
    show(plot(prime_pi, 0, N, color="red")+plot(x/(log(x)-1), 5, N, color="blue"))
```

Try putting different numbers in the input box.

5. Let’s do the same thing in a new way. Try:

```
@interact
def pnt2(N=(100, (2..1000000))):
    show(plot(prime_pi, 0, N, color="red")+plot(x/(log(x)-1), 5, N, color="blue"))
```

What part of the code is producing the *slider*?

6. **Eigenvalues.** Try `M=identity_matrix(3)`. Evaluate M to see the entries. Change the upper right corner entry to 3. Use `M.` and `TAB` to find the eigenvalues and eigenvectors of M
7. Here's an INTERACT with an *update* button.

```
@interact
def _(m=("matrix", identity_matrix(2)), auto_update=False):
    print(m.eigenvalues())
```

Try different values in the matrix and then and then click the update box. Now make a 3×3 matrix.

Files & Data Challenge

Reading in, and working with, data files is an important ability. Last class we created a data file (`one_hundred_numbers.txt`), learned how to read it in line-by-line, and work with the data. An important thing to know/note is that a file is actually a big *string*. You can read the lines of a file with `readline()`. Those lines are also strings (and not numbers - despite how they look). If you want numbers they must be converted to numbers.

Problems

8. The sum of the reciprocals of the positive integers

$$\sum_{n=1}^{\infty} \frac{1}{n}$$

diverges (that is, the sum goes to infinity).

- (a) Find the smallest integer m so that $\sum_{n=1}^m \frac{1}{n}$ is at least 2.
 - (b) Find the smallest integer m so that $\sum_{n=1}^m \frac{1}{n}$ is at least 3.
 - (c) Find the smallest integer m so that $\sum_{n=1}^m \frac{1}{n}$ is at least 4.
9. Here's a **multi-step problem that builds on what we did last class**. Create a new file `two_hundred_numbers.txt` that consists of each line from `one_hundred_numbers.txt` written twice. (If you don't have `one_hundred_numbers.txt` In put a copy in your CoCalc Project Handouts folder.

Getting your classwork recorded

When you are done, before you leave class...

- (a) Click the "Make pdf" (Adobe symbol) icon and make a pdf of this worksheet. (If Cocalc hangs, click the printer icon, then "Open", then print or make a pdf using your browser).
- (b) Send me an email with an informative header like "Math 255 - c27 worksheet attached" (so that it will be properly recorded).
- (c) Remember to attach today's classroom worksheet!