LARSON—MATH 255–CLASSROOM WORKSHEET 14
Dictionaries and Problems

1. (a) Start the Chrome browser.
   (b) Go to `http://cocalc.com`
   (c) You should see an existing Project for our class. Click on that.
   (d) Click "New", then "Sage Worksheet", then call it **c16**.
   (e) For each problem number, label it in theSAGE cell where the work is. So for Problem 1, the first line of the cell should be `#Problem 1`.

Streaks of Heads and Tails

2. We would now like to investigate longest streak of heads or tails in a sequence of coin flips. We will first need to generate data. Write a function `coin_flips(n)` that *returns* a list of n "heads" or tails". Test your function.

3. Let `flip_data = coin_flips(100)`.

4. One way to investigate our data it it to first find the length of the streak that starts at any specified index in your `flip_data` list. Define a function `streak_at_i(flip_data,i)` that inputs a list of 'H' and 'T' strings, an index i, and returns the length of the streak whose first term is `flip_data[i]`. Test it on some data to see if its working.

5. Now we have a tool we can to a longest streak of heads or tails in our data. Use `streak_at_i(flip_data,i)` for $i \in [0..99]$ and keep track of the largest value you get.

6. This is a single *experiment*. Now repeat this experiment many times and see what the average length of a longest string is.

7. Now investigate the average length of a longest streak of heads or tails when you flip a coin **200** times.

A Formula for Primes?

8. When $n = 0$, $n^2 - 79n + 1601$ is 1601—which is prime. When $n = 1$, $n^2 - 79n + 1601$ is 1523—which is prime. Find the smallest value of n where $n^2 - 79n + 1601$ is *not* prime.

Files

9. Now it is the case on any larger program that you will want to use functions you have previously defined. These are called *tools*. Instead of copying and pasting from your old code. You can save them as *files* and load them as needed.

   (a) Click "New". Type `heads_from_n_flips.sage` and then click "file". (You are making a **.sage** file *not* our usual Sage Worksheet file. These are regular text files that are loaded as Python files plus some *preprocessing*).

   (b) Define the function:

```
def heads_from_n_flips(n):
    heads=0
    for i in [1..n]:
        if random() < 0.5:
            heads=heads+1
    return heads
```

   (c) Click "Save" and then go back to your **c16** worksheet.

   (d) Type `load("heads_from_n_flips.sage")` and evaluate.

   (e) Now try `heads_from_n_flips(100)` a few times. You never need to write this function again. You have a tool!

10. Add a print statement to `heads_from_n_flips.sage` that indicates that the file has in fact been loaded. Test it.

Working with Files

Reading in, and working with, data files is an important ability. First we will create a data file. Then we will read it in line-by-line, and then we will 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.

11. (a) Go to: `http://projecteuler.net/problem=13`. Copy the one hundred 50-digit numbers there.
    (b) Click "New", type in `one_hundred_numbers.txt` as the name of your file, then click "File".
    (c) Paste in your numbers and "Save".
    (d) Now go back to your **c25** worksheet.
    (e) Type in:

```
data=open("one_hundred_numbers.txt")
numbers=[]
number_string=data.readline()
while(number_string!=""):
    number=Integer(number_string)
    numbers.append(number)
    number_string=data.readline()
```

    You have a *list* of numbers. You can use built-in Sage functions to find out statistics about this list.

12. How many numbers are there?
13. What is the biggest number?
14. What is the sum of these numbers?
15. What is the average of these numbers?
16. What is their median?

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 - c16 worksheet attached" (so that it will be properly recorded).
(c) Remember to attach today's classroom worksheet!