LARSON—MATH 255–CLASSROOM WORKSHEET 13
Experiments

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 **c13**.

    (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.

Collatz conjecture

Start with any positive integer x. If x is even divide by 2. If x is odd, multiply by 3 and add 1. Repeat. Try this for several initial starting numbers x. For any number you try you'll eventually get to 1. No one knows why or if it's true for all numbers (its been tested up to some very large number).

2. Define a function collatz(x) that returns x if x is one, returns collatz(3x+1) if x is odd, and returns collatz(x/2) if x is even. This will be a recursive function (since it calls itself). What is the base case? Does it always terminate (return 1)?

3. Add a print/debugging statement to your collatz function so you can see what the input is every time that function is called.

Random Values

We previously wrote a coin flipping program and tested that for 100 and 1000 coin-flips. The results we got were in the ballpark of 50% heads. Now lets write some code to make it easy to perform multiple experiments.

4. Define a function heads_percentage(n) that inputs a positive integer n and outputs the percentage of heads after n coin flip experiments.

5. Use scatter_plot to sketch a graph of the results of heads_percentage(n) for values of n from 1 to 10000.

It is often useful to generate **random integers**. It only makes sense to generate random integers from within some range of integers. We do this with `randint()`.

6. Evaluate `randint(5,100)` a few times; your results will vary. This will generate random integers in the range $[5, 100]$, including both endpoints.

7. Now try the following function. Evaluate it a few times; your results will vary!

```
def sybil():
    print("My favorite number is {}!".format(randint(1,50)))
```

8. **Investigate**. Does `randint()` produce a *uniform distribution*? (That is, as you repeat experiments of `randint(a,b)` are the number of produced outcomes of each possible integer roughly the same? Do some experiments! How will you keep track of the data?)

9. **Problem.** Find the sum of the *even* Fibonacci numbers that are no more than four million.

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 - c13 worksheet attached" (so that it will be properly recorded).

(c) Remember to attach today's classroom worksheet!