1. Log in to your Sage/Cocalc account.

(a) Start the Chrome browser.
(b) Go to http://cocalc.com and sign in.
(c) You should see an existing Project for our class. Click on that.
(d) Click “New”, call it c20, then click “Sage Worksheet”.

The **Main Questions** are:
(1) When you flip a coin 100 times would you expects to see 6 heads or tails in a row at some point? We can investigate this question too by simulating coin flips and repeating our experiment a number of times; and,
(2) If you flip a coin 100 times, you would expect about 50 heads. Its possible that you could get 100 heads. But this would be rare. How rare? We can simulate flipping a coin a hundred times, write down how many heads we got, and then repeating this experiment. This will give us a distribution of various possible outcomes.

Here are functions we defined last class:

```
def coin_flip():
    if random() < 0.5:
        return 'H'
    else:
        return 'T'

def coin_flips(n):
    return [coin_flip() for i in range(n)]

def longest_run_of_heads(n):
    flip_results = coin_flips(n)
    last = flip_results[0] #last records the previously looked at coin flip
    countH = 0 #records the length of the current streak of heads
    longestH = 0 #records the length of the longest streak of heads

    #this block records whether the initial flip is heads or tails
    if last == "H":
        countH = 1
        longestH = 1
    else:
        countH = 0
        longestH = 0
```
for i in [1..(n-1)]:
    current = flip_results[i] # current is the currently looked-at flip
    if current == "H" and last == "T":
        countH += 1 # the streak of T's is over
        last = "H" # the currently looked-at flip becomes the last looked-at
    elif current == "H" and last == "H":
        countH += 1
        last = "H" # the currently looked-at flip becomes the last looked-at
    elif current == "T" and last == "H": # current streak of heads is over
        countH = 0
        last = "T" # the currently looked-at flip becomes the last looked-at
    if countH > longestH: # check if the just-finished streak is longer
        longestH = countH
print "The longest streak of heads is " + format(longestH)
return longestH

2. Write a function `longest_run(n)` that returns the length of a longest run of either heads or tails after flipping a coin n times.

3. If you flip a coin 100 times what is the average length of a longest run of heads or tails? We can get an idea by repeating our experiment several times, collecting the data and finding the average.

   ```python
def repeat_experiments(n):
    total = 0.0
    for i in [1..n]:
        current_experiment = longest_run(100)
        total = total + current_experiment
    return total/n
```

   Try `repeat_experiments(10)`, `repeat_experiments(100)`, and `repeat_experiments(1000)`.

4. What is the probability of getting a run of at least 6 heads or tails when you flip a coin 100 times?

   ```python
def repeat_experiments2(n):
    long_run_count = 0.0
    for i in [1..n]:
        if longest_run(100) >= 6:
            long_run_count += 1
    return long_run_count/n
```

   Try `repeat_experiments2(10)`, `repeat_experiments2(100)`, and `repeat_experiments2(1000)`. 