LARSON—MATH 255–CLASSROOM WORKSHEET 12
Programming Control Flow—*while* loops.

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 **c12**.
   (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`.

Review

2. **What is the difference between `return` and `print`?** When is this difference important?

   A *while loop* runs a block of code while a condition is still satisfied. A common way to use a while loop is in a test where you don't know precisely when the test condition will be met.

3. A common way to use a while loop is in a test where you don't know precisely when the test condition will be met. Here we will write a function that finds which letter of a word is the first occurrence of the letter "a". The program prints "no a's when there is no "a" in the word.

```
def find_first_a(word):
    length=len(word)
    i=0
    while i<length:
        if word[i]=="a":
            return i
        else:
            i=i+1
    print("{} contains no a's".format(word))
```

   Test your function with a variety of strings/words.

Challenges

4. **First Challenge**. You won't learn just by typing in code examples. It helps. Put you've got to solve stuff—if you are to develop real skills you can use in your other classes.

   2520 is the smallest number that can be divided by each of the numbers from 1 to 10 without any remainder. What is the smallest positive number that is evenly divisible by all of the numbers from 1 to 20.

Intermediate Value Theorem

If $f(x)$ is a continuous function, and $f(a) \leq c \leq f(b)$ then there is some real number x in the interval $[a, b]$ where $f(x) = c$ (that's the **Intermediate Value Theorem**). We will define a function that finds this x. We will do this in steps.

5. Given a continuous function $f(x)$, and numbers a, b and c, define a function `check_conditions(f,a,b,c)` that returns True if $f(a) \leq c \leq f(b)$ and False otherwise. Evaluate.

6. Let $f(x) = x^2$. Evaluate `check_conditions(f,1,2,3)` and `check_conditions(f,1,2,5)`. Is the output what you expected?

7. Given a continuous function $f(x)$, and numbers a, b and c, define a function `test_average(f,a,b,c)` that returns the tuple $(a, (a+b)/2)$ if $f((a+b)/2) \geq c$ and returns $((a+b)/2, b)$ if $f((a+b)/2) < c$.

8. What can you do now to find the intermediate value x where $f(x) = c$?

   One idea is to successively find smaller and smaller intervals where the x must be (where $f(x) = c$). If we keep splitting our original interval in half, in n steps we will find that our x must be in an interval of length $\frac{1}{2^n}(b-a)$; in the limit this interval length is going to 0 and any x in the n^{th} interval will be within a very small error or tolerance.

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 - c12 worksheet attached" (so that it will be properly recorded).

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