Last name _____

First name _____

LARSON—MATH 255–CLASSROOM WORKSHEET 07
Matrices.

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 **c07**, then click "Sage Worksheet".
   (e) For each problem number, label it in the Sage cell where the work is. So for Problem 1, the first line of the cell should be `#Problem 1`.

2. `is_prime()` is a built-in Sage function which tests if an integer is prime. Try `is_prime(5)`, `is_prime(6)`, `is_prime(47)`, and `is_prime(34567)`

3. Let `L=[1..50]`. Now use `is_prime` and either `filter` or a list comprehension to filter the primes from list L.

4. Define a function `foo(x,y)` that takes real numbers x and y and returns $3x + y$.

5. Alternatively you could define and name an anonymous function:

   ```
   foo = lambda x,y: 3*x+y
   ```

   Now try `foo(4,5)`. Note that you never needed to define "y" as a variable.

   Matrices

6. We can represent the system of linear equations $\begin{cases} 2x + y = 5 \\ x + 3y = 7 \end{cases}$ with the matrix $A = \begin{bmatrix} 2 & 1 & 5 \\ 1 & 3 & 7 \end{bmatrix}$

   Enter this in Sage using: `A=matrix(2,3,[2, 1, 5, 1, 3, 7])`.

   Use `A.rref()` to find a matrix that represents an equivalent system in *row-reduced echelon form*.

7. Consider the system: $\begin{cases} x + 3y = 5 \\ x + 3y = 7 \end{cases}$

   Find a matrix that represents this system, find the row-reduced echelon form of this matrix, rewrite this as an equivalent system of linear equations and interpret.

8. Consider the system: $\begin{cases} x + y = 5 \\ 2x + 2y = 10 \end{cases}$

   Find a matrix that represents this system, find the row-reduced echelon form of this matrix, rewrite this as an equivalent system of linear equations and interpret.

9. Let `A=matrix(2,2,[1,2,3,4])`, and `b=vector([5,6])`. Solve the matrix equation $A\hat{x} = \hat{b}$ using `A.solve_right(b)`.

10. **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.

Programming

A *for loop* is what we use when we want our code to run through every item x in a list.

11. Evaluate and test the following function. What do you think this function will do?

```
def for_loop_test():
    for i in [0..5]:
        print i^2
```

12. Modify your code to print the squares of the integers from 5 to 9. How did you change it?

13. Modify the code to print just the squares of 2, 5, 7 , 9, and 23. How did you change it?

14. The function `list_evens(n)` that returns all the even integers from 0 to n. Evaluate and test the following code.

```
def list_evens(n):
    M=[]
    for x in [0..n]:
        if x%2==0:
            M.append(x)
    return M
```

15. Write a function list_primes(n) that **returns a list** of all the primes up to n. Test it.

16. Write a function count_primes(n) that **returns a count** of all the primes up to n. Test it.

17. Write a function count_prime_list(L) that **returns a count** of all the primes in an input list L. Test it.