Last name _____

First name _____

LARSON—MATH 310–CLASSROOM WORKSHEET 04
Getting Started with CoCalc.

1. Set up your CoCalc JUPYTER notebook for today's work.

   (a) Start the Chrome browser.

   (b) Go to `https://cocalc.com`

   (c) Log in.

   (d) You should see an existing Project for our class. Click on that.

   (e) Make sure you are in your Home directory (if you work in your Handouts directory, your work could get overwritten).

   (f) Click "New", then "Jupyter Notebook", then call it **310-c04**.

   (g) Make sure you have PYTHON as the *kernel*.

   Review

   (a) What is the difference between a *function* and a *procedure*?

   (b) Suppose a and b are integers. What PYTHON command will give you the *remainder* of dividing a by b? How can you find the *quotient* (the number of times b goes into a)?

   (c) What PYTHON operation can you use to compare equality of numerical quantities (and *in*equality)?

   (d) What PYTHON procedure will output the *cardinality* (or length) of a set (or list, or dictionary)?

   (e) What PYTHON operator can you use to test whether an element x is in a set S?

   (f) What is a *set comprehension*?

   Chp. 0

2. What is `range`? Code and run.

```
list(range(10))
```

3. What is `zip`? Code and run.

```
list(zip([1,3,5],[2,4,6]))
```

4. What is a *dictionary*? Code and run.

```
D = {'A':0, 'B':1, 'C':2, 'D':3, 'E':4, 'F':5, 'G':6, 'H':7, 'I':8,
'J':9, 'K':10, 'L':11, 'M':12, 'N':13, 'O':14, 'P':15, 'Q':16,
'R':17, 'S':18, 'T':19, 'U':20, 'V':21, 'W':22, 'X':23, 'Y':24,
'Z':25}
```

5. What are the *keys* of dictionary D? What are the *values*? How do you find the value associated to a given key?

6. How can you check if there is an entry in dictionary D for a particular key?

7. How can you add a new key-value pair to a dictionary (say *key:value* to dictionary D)?

8. (**Task 0.6.2**) The module `random` defines a procedure `randint(a,b)` that returns an integer chosen uniformly at random from among $a, a+1, ..., b$. Import this procedure using the following command then try randint a few times. Code and run.

```
from random import randint
```

Chp. 1. Complex Numbers

9. Define a complex number $z = 3 + 4j$ using the `complex` constructor. Code and run.

```
z=complex(3,4)
z
```

10. Recover the real part of z with the `.real` attribute. Code and run.

```
z.real
```

11. Recover the real part of z with the `.imag` attribute. Code and run.

```
z.imag
```

12. Find the (complex) conjugate of z with the `.conjugate` method. Code and run.

```
z.conjugate()
```

13. Find the absolute value (or length of the Z arrow in the complex plane) of z using `abs`. Code and run.

```
abs(z)
```

14. Find the multiplicative inverse of z as a reciprocal. Code and run.

```
1/z
```

15. Test that your answer is the multiplicative inverse of z.

16. (**Multiplying a complex number by a scalar**). Find the length of $2z$.

17. Here is our author's definition of a *vector*.

Definition 2.2.2: For a finite set D and a field $\mathbb{F}$, a *D-vector over $\mathbb{F}$* is a function from D to $\mathbb{F}$.

This is a computer scientist's definition; it lends itself to representation in a data structure. It differs in two important ways from a mathematician's definition.

- I require the domain D to be finite. This has important mathematical consequences: we will state theorems that would not be true if D were allowed to be infinite. There are important mathematical questions that are best modeled using functions with infinite domains, and you will encounter them if you continue in mathematics.
- The traditional, abstract approach to linear algebra does not directly define vectors at all. Just as a field is defined as a set of values with some operations (+, -, *, /) that satisfy certain algebraic laws, a vector space is defined as a set with some operations that satisfy certain algebraic laws; then vectors are the things in that set. This approach is more general but it is more abstract, hence harder for some people to grasp. If you continue in mathematics, you will become very familiar with the abstract approach.

Returning to the more concrete approach we take in this book, according to the notation from Section 0.3.3, we use $\mathbb{F}^D$ to denote the set of functions with domain D and co-domain $\mathbb{F}$.

18. Look in the Handouts folder for the *vec.py* file and the *class* definition of the vector class `Vec`.

Getting your classwork recorded

When you are done, before you leave class...

(a) Click the "Print" menu choice (under "File") and make a pdf of this worksheet (html is OK too).

(b) Send me an email (`clarson@vcu.edu`) with an informative header like "Math 310 - c04 worksheet attached" (so that it will be properly recorded).

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