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 c08, then click “Sage Worksheet”.

More Lists
A list in Sage is a mutable object. Its entries can be changed.

2. Let $L=[1, 2, 1, 2,1]$. Evaluate $L[0]$ (you will get the 0th entry of $L$; it should be 1).

3. $L[0]$ can be changed. Evaluate $L[0]=5$. Now evaluate $L$.


5. Try $L.append(4)$. Evaluate $L$.

6. Try $L.remove(3)$. What do you get?

7. Try sum($L$). What do you get? What did Sage do?

8. Try prod($L$). What do you get? What did Sage do?


10. Try map(factorial,[1,2,3,4,5]). What do you get? Explain?

11. What do you think the value of sum(map(exp,[1,2,3,4,5])) will be? Try it.

Tuples

A tuple is a Sage object, similar to a list, but with curved brackets instead of square brackets. These include pairs like (2, 3), triples like (4, 5, 6), etc.

12. Let $t=(2,3)$. Then evaluate $t$, and evaluate type($t$).

13. You can find the entries in a tuple just like you can with a list. Try $t[0]$, $t[1]$ and $t[2]$. 
14. Try to change the 0\textsuperscript{th} entry of \( t \). Evaluate \( t[0] = 5 \).

**Sets**

15. Let \( L = [2, 3, 3, 2, 1, 8, 6, 3] \) and \( A = \text{Set}(L) \). Evaluate \( A \). What happened?

16. Find how many elements set \( A \) has with \( A\text{.cardinality()} \).

17. Try: \( 8 \text{ in } A \). What do you get? Try: \( 9 \text{ in } A \).

18. Let \( B = \text{Set}([8, 6, 17, -4, 20, -2]) \). Try \( A\text{.union}(B) \). What do you get?

19. Try \( A\text{.intersection}(B) \).

20. Let \( R = \{1, 2, 3\} \), and \( S = \{2, 3, 4\} \). What is the set \( R\text{-}S \)? Try \( R\text{.difference}(S) \) and \( S\text{.difference}(R) \).

**More Anonymous Functions**

An *anonymous function* is just a function without an associated name and, thus, not meant for reuse. They can be useful in order to save defining an auxiliary function (especially if you have no intention of using that auxiliary function for anything else). We used a a “lambda construction” on the last worksheet.

21. Define a function \( \text{filter\_evens}(L) \) that takes a list \( L \) of integers as input and returns a new list which is exactly the even integers that were in \( L \).

22. Suppose you only intended to do this once ever. Then you don’t need to define a function. If you wanted to filter the even integers from \( L = [1, 2, 3, 4, 5, 6] \) you could do the following:

\[
\text{filter}(\lambda x: x \% 2 == 0, L)
\]

**Matrices**

23. We can represent the system of linear equations
\[
\begin{align*}
2x + y &= 5 \\
x + 3y &= 7
\end{align*}
\]

with the matrix \( A = \begin{bmatrix} 2 & 1 & 5 \\ 1 & 3 & 7 \end{bmatrix} \). Enter this in Sage using: \( A = \text{matrix}(2, 3, [2, 1, 5, 1, 3, 7]) \). Evaluate \( A \).