1. Log in to your Sage Cloud account.
   
   (a) Start the Chrome browser.
   (b) Go to http://cloud.sagemath.com and sign in.
   (c) You should see an existing Project for our class. Click on that.
   (d) Click “New”, call it c06, then click “Sage Worksheet”.

Lists in Sage

A list is a basic data structure in Python and Sage. They are represented by square brackets with comma separated numbers, strings, etc., between them (like [2, 5, 9] or ["red", "blue"]). We have already seen lists in our use of both the solve() and line() commands which used, respectively, a list of equations and a list of points.

2. Lists can be given names. Evaluate \( L = [2, 5, 9] \). Then evaluate \( L \).


4. Lists can be combined with “+”. Evaluate \( [2, 5, 9] + [3, 4, 5] \).

5. Let \( M = [3, 4, 5] \). Evaluate \( L + M \).

6. If you want all the integers from \( x \) to \( y \) you can use the shorthand notation \([x..y]\). Evaluate \( [3..7] \).

7. If you want a list with \( m \) n’s you can use the shorthand notation \( [n] * m \). Evaluate \( [0] * 7 \).

8. You can have a list of lists. Evaluate \( L = [[0, 1], [2, 3], [4, 5]] \). Now evaluate \( L[1] \). Then evaluate \( L[1][0] \). What do you think the value of \( L[0][1] \) is?

9. You can use map() to apply a function to each term of a list. Let \( f(x) = x**2 \). Evaluate \( \text{map}(f(x), [2, 5, 9]) \).

10. What could you write to produce a list of all the cubes of the integers from 2 to 17?

11. You can also use list comprehension to get the same behavior as map(). Evaluate \( [x**2 \text{ for } x \text{ in } [2, 5, 9]] \).

12. Use list comprehension to produce a list of the cubes of all the integers from 2 to 17.
13. List comprehension can also be used to filter the numbers in a list. Evaluate \([x \text{ for } x \text{ in } [2,5,9] \text{ if } x\%2==0]\). What did this do?

14. Evaluate \([x \text{ for } x \text{ in } [2,5,9] \text{ if } x\%2==1]\). What did this do?

**Calculus in Sage**

15. Find the derivatives for \(x^2\), \(2x^4\), \(\log(x)\), \(\sin(x)\), \(e^{2x}\), and \(x^x\) using the command \texttt{diff(f(x),x)} (put your function in for \(f(x)\)).

16. Find the 2\textsuperscript{nd} derivatives for \(x^2\), \(2x^4\), \(\log(x)\), \(\sin(x)\), \(e^{2x}\), and \(x^x\) using the command \texttt{diff(f(x),x,2)} (put your function in for \(f(x)\)).

17. Let \(g(x) = x^x\). Sketch the graph of \(g(x)\). Let \(gprime(x) = \texttt{diff}(g(x),x)\). Evaluate \(gprime(1)\) and \(gprime(0)\). Explain.

18. Sketch the graph of \(gprime(x)\). Solve when \(gprime(x) = 0\).

19. Evaluate \texttt{derivative(g(x))}. \texttt{(diff())} is just shorthand for \texttt{derivative()}.

20. Find \(g(x).\texttt{derivative()}\).

21. Let \(h(x,y)=xy\). Find \(\frac{\partial h}{\partial x}\) the partial derivative of \(h(x)\) with respect to \(x\) by hand. Then evaluate \(h(x,y)=xy\), and \(\texttt{diff(h(x,y),x)}\).