# LARSON—MATH 255–CLASSROOM WORKSHEET 06
## Strings, Booleans, and More.

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 **c06**.
   (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`.

**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=[2,3,5,9]`. Then evaluate `L`.
3. Lists are indexed starting with 0. Evaluate each of `L[0]`, `L[1]`, `L[2]`, and `L[3]`.
4. Lists can be combined with "+". Evaluate `[2,3,5,9]+[3,4,5]`. (Note: any common elements are repeated.)
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 *list comprehension* to get a list of the values of any function applied to an initial list. Evaluate `[x**2 for x in [2,5,9]]`.
10. Use list comprehension to produce a list of the cubes of all the integers from 2 to 17.
11. List comprehension can also be used to *filter* the numbers in a list. Evaluate `[x for x in [2,5,9] if x%2==0]`. What did this do?
12. Evaluate `[x for x in [2,5,9] if x%2==1]`. What did this do?

**Calculus in Sage**

13. Find the derivatives for $x^2$, $2x^4$, $log(x)$, $sin(x)$, $e^{2x}$, and $x^x$ using the command `diff(f(x),x)` (put each function in for f(x)).

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

15. Let $g(x) = x^x$. Sketch the graph of $g(x)$. Let `gprime(x)=diff(g(x),x)`. Evaluate `gprime(1)` and `gprime(0)`. Explain.

16. Sketch the graph of $gprime(x)$. Solve when $gprime(x) = 0$.

17. Evaluate `derivative(g(x))`. (`diff()` is just shorthand for `derivative()`.

18. Find `g(x).derivative()`.

19. 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 `diff(h(x,y),x)`.

20. Let h(x,y)=xy. Find `diff(h(x,y),x)`.

21. Find $\frac{\partial h^2}{\partial x \partial y}$. Now try diff(h(x,y),x,y)

22. Find $\frac{\partial h^2}{\partial x \partial x}$.

23. Try `h.derivative()`. Explain what you get.

24. Find $\int 3x\, dx$ by hand. Check with `integral(3*x,x)`.

25. Let f(x)=3x. Let fint=integral(3*x,x). Check that diff(fint,x)=f(x).

26. Find $\int_1^2 f(x)\, dx$ by hand. Check using `integral(f(x),x,1,2)`.

27. Sketch $g(t) = t^{20}e^t$ on $(0, 3)$.

28. Find $\int t^{20}e^t\, dt$.

29. Find $\int_2^3 t^{20}e^t\, dt$.

30. Find a numerical approximation for $\int_2^3 t^{20}e^t\, dt$.

31. Try `numerical_integral(`$t^{20}e^t$`, 2, 3)`.

32. Find out what the second number of your answer means.

**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 - c05 worksheet attached" (so that it will be properly recorded).

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