LARSON—MATH 255–CLASSROOM WORKSHEET 08
Calculus.

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 **c08**.
   (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`.

   Review

   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"]`).

2. If you want all the integers from x to y you can use the shorthand notation $[x..y]$. Evaluate `[3..7]`.

3. If you want a list with m n's you can use the shorthand notation $[n] * m$. Evaluate `[0]*7`.

4. 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?

5. 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]]`. Evaluate `[x for x in [2,5,9] if x%2==1]`. What did this do?

   More Lists

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

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

7. L[0] can be changed. Evaluate `L[0]=5`. Now evaluate L.

8. Let L = [2,3,3,3,2,1,8,6,3]. Try L.sort(). What does Sage do?

9. Try L.append(4). Evaluate L.

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

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

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

13. Try [cos(x) for x in [0, pi/4, pi/2, 3*pi/4, pi]]. What do you get? Explain.

14. Try [factorial(x) for x in [1,2,3,4,5]]. What do you get? Explain?

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

More Calculus in Sage

16. 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)`.

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

30. Let `t=(2,3)`. Then evaluate t, and evaluate `type(t)`.

31. You can find the entries in a tuple just like you can with a list. Try $t[0]$, $t[1]$ and $t[2]$.

    A tuple in Sage is an *immutable* object. You can't change it.

32. Try to change the 0^{th} entry of t. Evaluate $t[0] = 5$.

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 - c08 worksheet attached" (so that it will be properly recorded).

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