LARSON—MATH 255–CLASSROOM WORKSHEET 05
Boolean Expressions, Lists, Calculus

1. Create a Cocalc/Sage Cloud account.

   (a) Start the Chrome browser.

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

   (c) "Create new account" using **your VCU email address** .

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

   (e) Click "New", then "Sage Worksheet", then call it **c05**.

   (f) For each problem number, label it in theSAGE cell where the work is. So for Problem 1, the first line of the cell should be `#Problem 1`.

   Review

2. Sketch the graph of $f(x) = x^5 + x^4 + x^3 - x^2 + x - 1$. Find the root (zero) of this function.

3. Now try `find_root(`$x^5 + x^4 + x^3 - x^2 + x - 1$`,-1,0)`. Explain the result.

   Boolean Expressions in Sage

   A *boolean expression* is one that evaluates to True or False.

   While "==" is used as a claim of equality of expressions (the left-hand-side and the right-hand-sides of the "==") the symbol "!=" is used to express in-equality.

4. Evaluate `5!=7`.

5. Evaluate `5!=5`.

6. We will *assign* a value to a variable "a". Then we will use that variable in a boolean expression. (These two lines can be typed in one cell, or each in its own cell). Type and evaluate:

   ```
   a=5
   a>2
   ```

   Boolean expressions can be combined with *boolean operators* like "and" and "or".

7. Evaluate: `3==3 and 3==4`.

8. Evaluate: `3==3 or 3==4`.

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.

9. Lists can be given names. Evaluate `L=[2,3,5,9]`. Then evaluate `L`.

10. Lists are indexed starting with 0. Evaluate each of `L[0]`, `L[1]`, `L[2]`, and `L[3]`.

11. Lists can be combined with "+". Evaluate `[2,3,5,9]+[3,4,5]`. (Note: any common elements are repeated.)

12. Let `M=[3,4,5]`. Evaluate `L+M`.

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

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

15. 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?

16. 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]]`.

17. Use list comprehension to produce a list of the cubes of all the integers from 2 to 17.

18. 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?

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

Calculus in Sage

20. 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)).

21. 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)).

22. 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.

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

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

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

26. 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)`.

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

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

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

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

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!