CS2810 Mathematics of Data Models	Gold
Spring 2019	March 11, 2019

Homework 06

Due: March 13, 9PM
Point total: 60

Instructions:

- Submit your PDF and/or .ipynb file to Blackboard by the due date and time. Please do not zip your files together, as this interferes with Blackboard's preview functionality. Always show all your work, and for full credit, you must use the method that the problem instructs you to use (unless none is mentioned). Handwritten or typeset solutions are both acceptable, but unreadable submissions will be penalized. You may discuss problems with other students, but you may not write up solutions together, copy solutions from a common whiteboard, or otherwise share your written work or code. Do not use code or language that is copied from the Internet or other students; attribute the ideas *and* rephrase in your own words.

Note that most of this assignment is in the associated Python notebook. If you like, you may turn in your answers to Problem 1 by creating a new first cell in this notebook, and answering there. Notice that notebooks accept Latex mathematical formatting (if it's between dollar signs).

Problem 1 (12 points [3,4,5])

i. Use the chain rule to find $\frac{\partial f}{\partial x}$ for the function $f(x, y) = (2x^2 + 3y^3)^{100}$. (You don't need to multiply out any large powers, but should otherwise simplify.)

ii. Use the chain rule twice to find $\frac{\partial f}{\partial x}$ for the function $f(x, y) = (\sin(2x^2 + 3y^3))^{100}$. (That is, the derivative of the first inner function will require another application of the chain rule.) Recall that the derivative of $\sin x$ is $\cos x$. You don't need to simplify more than in the last problem.

iii. Suppose one loss function in a machine learning application is $(y - f(w, x))^2$ - the squared error function covered in lecture - and another loss function is $(y - f(w, x))^{100}$. (y is the desired value, and f(x) is what the machine learning function outputs.) How would this numerically change the calculation of the derivative of the loss function with respect to w? (Give a formula in terms of $(y - f(w, x))$ for what this multiplies the old derivative by.)

Problem 2 (50 points)

The rest of this problem set is to be done in the Python notebook. If you find it more convenient to turn in only one file, you can answer problem 1 in a new cell that you create above the programming part of that notebook; note that notebooks accept Latex formatting.