Math 151 Study Guide – What we know about computing derivatives so far

<u>Things We Know We CAN Do</u>

- $f'(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$ (The definition of the derivative: this is the only reasonable approach to discussing what a derivative really is. Any other formula is just an algebra trick to make computing easier.)
- (Derivative of a number) $D_x(c) = 0$

  In Words: The derivative of any number is zero. This includes expressions that have some letter that is NOT the variable. For example, If $f(x) = a + 2b + c^2$, $f'(x) = 0$ because none of the letters in the function is the variable.
- (Number times variable) $D_x(cx) = c$

  In Words: To differentiate a number times a variable TO THE FIRST POWER, you just throw out the variable and leave the number behind.
- (The Power Rule) $D_x cx^n = ncx^{n-1}$

  In Words: Bring down the power and multiply by any number (the coefficient) that's already there, then SUBTRACT one from the power. NOTE: If the power is negative, be especially careful subtracting one from it. This rule ONLY works for terms that are in exactly the form cx^n. This means that anything under a root, or any term with x^n in the denominator, must first be rewritten using a fractional or negative exponent.
- (The Sum/Difference Rule) $D_x\left(f(x) \pm g(x)\right) = f'(x) \pm g'(x)$

  In words: To differentiate two pieces that are added or subtracted, you just compute the derivatives of the two pieces separately. (Of course, this is NOT TRUE FOR MULTIPLICATION AND DIVISION!)
- (The Constant Multiple Rule) $D_x(cf(x)) = cf'(x)$

  In words: You can always ignore a number, and just bring it along for the ride when you're differentiating. This is absolutely NOT true if it's not just a number.
- (Exponential Rule) $D_x\left(e^x\right) = e^x$

  In words: The derivative of e^x is itself. Only works if the base is *e*, and the exponent is just a single variable to the first power!

<u>Things We Know We CANNOT Do</u>

- You can NOT differentiate a product, like $f(x) = x^2 e^x$, by just differentiating the two factors (x^2 and e^x in this case) separately. It NEVER works. This is challenging because that technique DOES work for pieces added or subtracted, but does NOT work for pieces multiplied or divided.
- As mentioned above, you can also NOT differentiate a fraction, like $g(y) = \frac{y^2}{y-3}$ by differentiating the numerator and denominator separately. It would be nice if we could, but we can't. Sucks for us.