MATH 111: ESSENTIAL DERIVATIVES

Differentiation theorems. For differentiable functions f, g and a constant c, the following statements are true:

- $(f+g)' = f' + g'$ and $(cf)' = cf'$ [linearity]
- $(fg)' = fg' + f'g$ [product rule]
- $\left(\frac{f}{g}\right)' = \frac{gf' - fg'}{g^2}$ [quotient rule]
- $(f \circ g)'(x) = f'(g(x))g'(x)$ [chain rule]

Special derivatives. The following are special derivatives that are good to remember:

- $\frac{\mathrm{d}}{\mathrm{d}x} c = 0$, c any constant
- $\frac{\mathrm{d}}{\mathrm{d}x} x^r = rx^{r-1}$, r any real number [power rule]
- $\frac{\mathrm{d}}{\mathrm{d}x} \sin x = \cos x$
- $\frac{\mathrm{d}}{\mathrm{d}x} \cos x = -\sin x$
- $\frac{\mathrm{d}}{\mathrm{d}x} \tan x = \sec^2 x$

Here are a few more trig derivatives. You'll verify them on your next homework, and they too can be useful:

- $\frac{\mathrm{d}}{\mathrm{d}x} \cot x = -\csc^2 x$
- $\frac{\mathrm{d}}{\mathrm{d}x} \sec x = \sec x \tan x$
- $\frac{\mathrm{d}}{\mathrm{d}x} \csc x = -\csc x \cot x$

You'll also compute these derivatives of inverse trig functions which are even more useful:

- $\frac{\mathrm{d}}{\mathrm{d}x} \arccos x = \frac{-1}{\sqrt{1-x^2}}$
- $\frac{\mathrm{d}}{\mathrm{d}x} \arcsin x = \frac{1}{\sqrt{1-x^2}}$
- $\frac{\mathrm{d}}{\mathrm{d}x} \arctan x = \frac{1}{1+x^2}$

When we get to Chapter 5 and define the natural logarithm function, $\log$, and its inverse, e^x, we'll also learn that:

- $\frac{\mathrm{d}}{\mathrm{d}x} \log x = \frac{1}{x}$
- $\frac{\mathrm{d}}{\mathrm{d}x} e^x = e^x$
- $\frac{\mathrm{d}}{\mathrm{d}x} c^x = c^x \log c$.

Date: 26.IX.14.