Calculus Review

Differentiation

Rule	Form	Example
Sum	$\frac{\partial}{\partial x}(a+b) = \frac{\partial a}{\partial x} + \frac{\partial b}{\partial x}$	$\frac{\partial}{\partial x}\left(x^2 + x^3\right) = 2x + 3x^2$
Difference	$\frac{\partial}{\partial x}(a-b) = \frac{\partial a}{\partial x} - \frac{\partial b}{\partial x}$	$\frac{\partial}{\partial x}\left(x^2 - x^3\right) = 2x - 3x^2$
Product	$\frac{\partial}{\partial x}(ab) = a \cdot \frac{\partial b}{\partial x} + \frac{\partial a}{\partial x} \cdot b$	$\frac{\partial}{\partial x}\left(x^2 x^3\right) = (2x)(x^3) + (x^2)(3x^2)$
Quotient	$\frac{\partial}{\partial x}\left(a/b\right) = \frac{\left[\frac{\partial a}{\partial x} \cdot b - a \cdot \frac{\partial b}{\partial x}\right]}{b^2}$	$\frac{\partial}{\partial x}\left(x^3/x^2\right) = \frac{\left[3x^2 \cdot x^2 - x^3 \cdot 2x\right]}{(x^2)^2}$
Power	$\frac{\partial}{\partial x}(a^n) = n \cdot a^{(n-1)}$	$\frac{\partial}{\partial x}(x^7) = 7x^6$
Exponential	$\frac{\partial}{\partial x}(a^x) = a^x \ln(a)$	$\frac{\partial}{\partial x}(3^x) = 3^x \ln(3)$
...Therefore	$\frac{\partial}{\partial x}(e^x) = e^x$	
Logarithm	$\frac{\partial}{\partial x}(\log_n a) = (a \ln(n))^{-1}$	
...Therefore	$\frac{\partial}{\partial x}(\ln a) = a^{-1}$	
Reciprocal	$\frac{\partial}{\partial x}\left(1/a\right) = -\frac{\frac{\partial a}{\partial x}}{a^2}$	$\frac{\partial}{\partial x}(\sec x) = \frac{\partial}{\partial x}\left(\frac{1}{\cos x}\right) = \frac{-(-\sin x)}{\cos^2 x} = (\sec x)(\tan x)$
Chain Rule	$\frac{\partial y}{\partial x} = \frac{\partial y}{\partial u} \cdot \frac{\partial u}{\partial x}$	$\frac{\partial}{\partial x}(x^2)^3 = 3(x^2)^2 \cdot 2x$
...Alternately	$\frac{\partial}{\partial x} f(g(x)) = f'(g(x)) \cdot g'(x)$	
Trigonometry	$\frac{\partial}{\partial x}\sin(x) = \cos(x)$;	$\frac{\partial}{\partial x}\cos(x) = -\sin(x)$;	$\frac{\partial}{\partial x}\tan(x) = \sec^2(x)$

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