2.4 The Chain Rule

-- allows you to take the derivative of a function inside another function

If both f & g are differentiable functions, then:

$$\frac{d}{dx}[f(g(x))] = f'(g(x))\cdot g'(x)$$

-- take the derivative of the outside first, then multiply by the derivative of the inside. (this can be repeated if needed)

ex1) $h(x) = (2x - 5)^4$

$h'(x) = 4(2x-5)^3\cdot(2)$

2) $f(x) = \sin(2x+3)$ $= \sin u$, $u=2x+3$

$f'(x) = \cos(2x+3)(2)$ $f' = \cos u \cdot u'$

$= \cos(2x+3)\cdot 2$

3) $g(x) = \tan^2 x = (\tan x)^2$

$g'(x) = 2(\tan x)^1 \cdot \sec^2 x$

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General Power Rule

-- a special case of the chain rule

If u is a differentiable function of x and n is any rational number, then:

$$\frac{d}{dx}[u^n] = n\cdot u^{n-1}\cdot u'$$

ex) $f(x) = \sqrt[3]{(x^2-1)^2} = (x^2-1)^{2/3}$

$f' = \frac{2}{3}(x^2-1)^{-1/3}\cdot(2x) = \frac{4x}{3\sqrt[3]{x^2-1}}$

1) $f(x) = -3\cdot\sqrt[4]{2-9x} = -3(2-9x)^{1/4}$

find f'

$f' = -\frac{3}{4}(2-9x)^{-3/4}(-9)$

$= \frac{27}{4\sqrt[4]{(2-9x)^3}}$

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2) $g(t) = \frac{-4}{(t+2)^2} = -4(t+2)^{-2}$

find g'(t)

$= 8(t+2)^{-3}(1)$

$= \frac{8}{(t+2)^3}$

3) Find the equation of the tangent line to the function at the given point:

$y = \frac{1}{(x^2-3x)^2}$ at x = 4 $(4, \frac{1}{16})$

$y = (x^2-3x)^{-2}$

$y' = -2(x^2-3x)^{-3}\cdot(2x-3)$

$= \frac{-4x+6}{(x^2-3x)^3} = \frac{-5}{32}$

$y - \frac{1}{16} = -\frac{5}{32}(x-4)$

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ex) $y = \sin^2(5x^3+1)$

$y = [\sin(5x^3+1)]^2$

$y' = 2[\sin(5x^3+1)]^1 \cdot \cos(5x^3+1)\cdot 15x^2$

hw: p133 # 9,17,21,33,45,49-59odd,67,74,75,81 89, 92, 100

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