Applications of Fractals

growth of tumor

cardiac arhythmias
healthy hearts are more chaotic

population growth – wildlife
bacteria

More Derivatives

Product Rule

$f(x) = (3x^7)(5x^4) = 15x^{11}$

$f'(x) = 165x^{10}$

~~$f'(x) = (21x^6)(20x^3)$~~

~~$= 420x^9$~~

$\frac{d}{dx} f \cdot g = f \cdot g' + g \cdot f'$

$= 1st \cdot d'2nd + 2nd \cdot d'1st$

$= (3x^7) \cdot (20x^3) + (5x^4)(21x^6)$

$= 60x^{10} + 105x^{10}$

$= 165x^{10}$

$f(x) = (x^4 + 2x + 5)(3x^8 - 7)$

$f(x) = \frac{x^4 - 3x + 7}{2x - 7}$

$g(x) = (x^7 + 3x^2 + 8)^{15}$

$f(x) = (7x^5 + 3x^8 - 2)(8x - \frac{7}{\sqrt[5]{x^2}} + 9)$

$-7x^{-2/5}$ -1

$f'(x) = (7x^5 + 3x^8 - 2)(8 + \frac{14}{5}x^{-7/5}) + (8x - \frac{7}{\sqrt[5]{x^2}} + 9)(35x^4 + 24x^7)$

1st d'2nd

Quotient Rule

$$\frac{d}{dx}\frac{f}{g} = \frac{g \cdot f' - f \cdot g'}{g^2}$$

$$f(x) = \frac{1}{x} = x^{-1}$$
$$f'(x) = -1x^{-2} = \frac{-1}{x^2}$$

$$\frac{low \cdot d'high - high \cdot d'low}{low^2}$$

$$f(x) = \frac{x^4 - 7x^3 + 8}{2x^5 - 17x^2}$$

$$f'(x) = \frac{\overbrace{(2x^5 - 17x^2)}^{low}\overbrace{(4x^3 - 21x^2)}^{d'high} - \overbrace{(x^4 - 7x^3 + 8)}^{high}\overbrace{(10x^4 - 34x)}^{d'low}}{(2x^5 - 17x^2)^2}$$

CHAIN RULE – function in a function

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

$f(x) = (x^2 - 7x + 3)^8$ $\quad x^8$, $8x^7$

$f'(x) = 8(x^2 - 7x + 3)^7 \cdot (2x - 7)$

$f(x) = \sqrt[3]{x^2 + 3x - 5(x^2+4)^9}$

$= (x^2 + 3x - 5(x^2+4)^9)^{1/3}$ $\quad 1/3 - 1$

$\sin(4x^2+7)$, x^2+7x, e

$f'(x) = \frac{1}{3}(x^2 + 3x - 5(x^2+4)^9)^{-2/3} \cdot (2x + 3 - 45(x^2+4)^8 \cdot 2x)$

$$f(x) = \frac{(x^3+7x^2)(4x^3-5x)}{(x^9-3)^{47}}$$

d'high

$$f(x) = \frac{(x^9-3)^{47}\cdot\overbrace{\left[\overbrace{(x^3+7x^2)}^{1st}\overbrace{(12x^2-5)}^{d'2nd}+\overbrace{(4x^3-5x)}^{2nd}\overbrace{(3x^2+14x)}^{d'1st}\right]}^{d'high} - \overbrace{(x^3+7x^2)(4x^3-5x)}^{high}\cdot\overbrace{47(x^9-3)^{46}\cdot 9x^8}^{d'low}}{\left((x^9-3)^{47}\right)^2}$$