Product and Quotient rules

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Product rule

Consider two functions $f(x) = x^3$ and $g(x) = x^2$. Compare

$$\frac{d}{dx}(f(x) \cdot g(x))$$

and

$$\frac{d}{dx}(f(x)) \cdot \frac{d}{dx}(g(x)).$$

Product rule

Theorem

$$\big(f(x)g(x)\big)' = f'(x)g(x) + f(x)g'(x)$$

Examples

Find the derivative of

- $x^3 e^{3x}$

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- $x^3 e^{3x}$
- $t^4 \ln(t+5)$

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- $(3x^2+6x)4^x$
- $\dfrac{e^{2t}}{\sqrt{t}}$

Quotient Rule

Theorem

$$\left(\frac{f(x)}{g(x)}\right)' = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$$

Examples

Find the derivative of the following functions

- $$\frac{5x^2 + 3}{x^3 + 4}$$

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- $$\frac{5x^2 + 3}{x^3 + 4}$$
- $$\frac{1}{1 + e^{-x}}$$

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- $$\frac{5x^2 + 3}{x^3 + 4}$$
- $$\frac{1}{1 + e^{-x}}$$
- $$\frac{e^x}{x^3}$$