Product and Quotient rules

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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

\[(f(x)g(x))' = f'(x)g(x) + f(x)g'(x)\]
Find the derivative of

\( x^3 e^{3x} \)
Find the derivative of

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

Product and Quotient rules
Find the derivative of

- $x^3 e^{3x}$
- $t^4 \ln(t + 5)$
- $(3x^2 + 6x)4^x$
Find the derivative of

- \( x^3 e^{3x} \)
- \( t^4 \ln(t + 5) \)
- \( (3x^2 + 6x)4^x \)
- \( e^{2t} \)
- \( \frac{1}{\sqrt{t}} \)
Quotient Rule

Theorem

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

Product and Quotient rules
Examples

Find the derivative of the following functions

- \[ \frac{5x^2 + 3}{x^3 + 4} \]
Examples

Find the derivative of the following functions

1. \( 5x^2 + 3 \)
2. \( \frac{x^3 + 4}{x^3 + 4} \)
3. \( \frac{1}{1 + e^{-x}} \)
Examples

Find the derivative of the following functions

\[
\frac{5x^2 + 3}{x^3 + 4}
\]

\[
\frac{1}{1 + e^{-x}}
\]

\[
\frac{e^x}{x^3}
\]