Higher-Order Derivatives

Lecture 17
Section 2.3

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Objectives

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- Higher-order derivatives.

The nth Derivative

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Let $f(x)$ be a function. The **first derivative** of $f(x)$ is $f'(x)$. For $n \geq 2$, then n**th derivative** of $f(x)$ is the derivative of the $(n-1)st$ derivative of $f(x)$.

Notation

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In prime notation, the derivatives are denoted

$$f'(x), f''(x), f'''(x), f^{(4)}, f^{(5)}, \ldots$$

In differential notation, the derivatives are denoted

$$\frac{df}{dx}, \frac{d^2f}{dx^2}, \frac{d^3f}{dx^3}, \frac{d^4f}{dx^4}, \frac{d^5f}{dx^5}, \ldots$$

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- $f(x) = 3x^2 + 5x - 9$
- $f(x) = \sqrt{x}$
- $f(x) = \dfrac{1}{x}$
- $f(x) = \dfrac{x}{x^2 - 1}$

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1. Draw the graph of $f(x) = \dfrac{x^2}{x^2+1}$ from $x = 0$ to $x = 2$.

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1. Draw the graph of $f(x) = \dfrac{x^2}{x^2+1}$ from $x = 0$ to $x = 2$.
2. Describe the shape of the graph.
3. Where is the graph the steepest (rising most rapidly)?

Examples

The graph of $f(x) = \dfrac{x^2}{x^2 + 1}$