

METIS

Lesson 4:

Common Derivatives



Introduction

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Lecture Overview:



Goals of the lecture:

1. Understand derivatives of some common functions

Derivatives of Common Functions

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Polynomials



$$f(x) = ax^n$$

$$f'(x) = anx^{n-1}$$

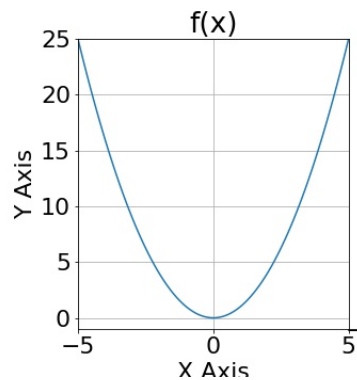
Polynomials



$$f(x) = ax^n$$

$$f'(x) = anx^{n-1}$$

$$f(x) = x^2$$



Polynomials

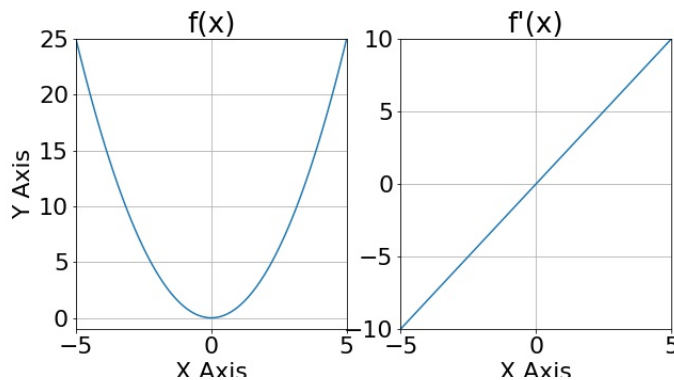


$$f(x) = ax^n$$

$$f'(x) = anx^{n-1}$$

$$f(x) = x^2$$

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

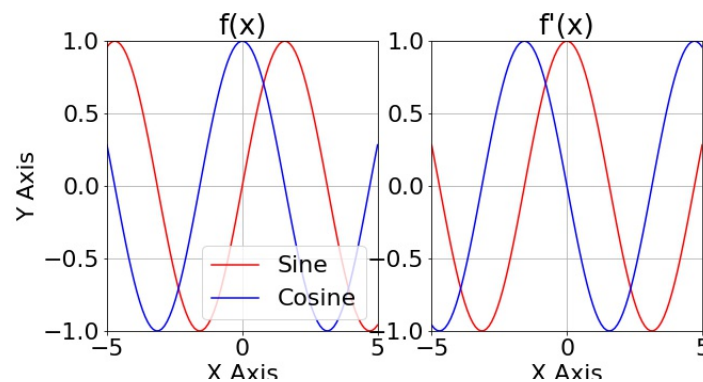


Trigonometric Functions



$$f(x) = \sin(x)$$

$$f'(x) = \cos(x)$$



$$f(x) = \cos(x)$$

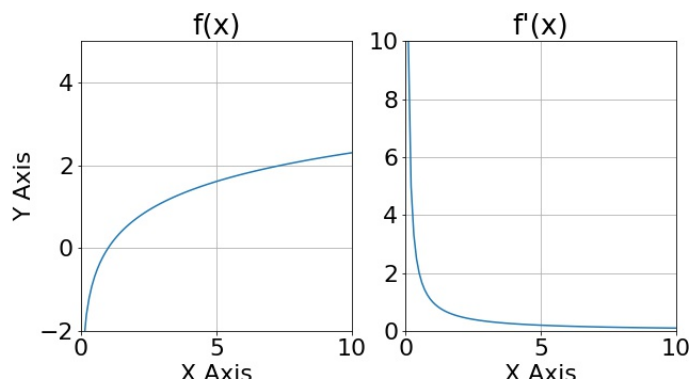
$$f'(x) = -\sin(x)$$

Logarithms Functions



$$f(x) = \ln(x)$$

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

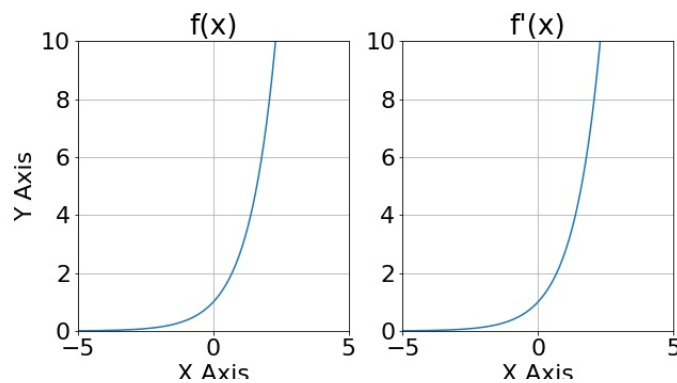


Exponential Functions



$$f(x) = e^x$$

$$f'(x) = e^x$$



Common Derivatives (Cheat Sheet)



Polynomials

$$\frac{d}{dx}(ax^n) = a \cdot nx^{n-1}$$

Radicals

$$\frac{d}{dx} \sqrt[m]{x^n} = \frac{d}{dx} \left(x^{\frac{n}{m}} \right) = \frac{n}{m} x^{\frac{n}{m} - 1}$$

Exponentials

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(a^x) = \ln(a) \cdot a^x$$

Logarithms

$$\frac{d}{dx} \ln(x) = \frac{1}{x}$$

$$\frac{d}{dx} \log_b(x) = \frac{1}{\ln(b)x}$$

Common Derivatives (Cheat Sheet)



Trigonometric

$$\frac{d}{dx} \sin(x) = \cos(x)$$

$$\frac{d}{dx} \cot(x) = -\csc^2(x) = -\frac{1}{\sin^2(x)}$$

$$\frac{d}{dx} \cos(x) = -\sin(x)$$

$$\frac{d}{dx} \sec(x) = \sec(x) \tan(x) = \frac{\sin(x)}{\cos^2(x)}$$

$$\frac{d}{dx} \tan(x) = \sec^2(x) = \frac{1}{\cos^2(x)}$$

$$\frac{d}{dx} \csc(x) = -\csc(x) \cot(x) = -\frac{\cos(x)}{\sin^2(x)}$$

Common Derivatives (Cheat Sheet)



Inverse Trigonometric

$$\frac{d}{dx} \arcsin(x) = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx} \arccos(x) = -\frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx} \arctan(x) = \frac{1}{1+x^2}$$

Problem 1:



Problem 1: Calculate $f'(x)$

$$f(x) = 2 \cdot x^{23}$$

Problem 1:



$$\frac{d}{dx}(ax^n) = a \cdot nx^{n-1}$$

$$f(x) = 2 \cdot x^{23}$$

$$a = 2$$

$$n = 23$$

$$f'(x) = 2 \cdot 23 x^{23-1}$$

$$f'(x) = 46 x^{22}$$

Problem 2:



Problem 2: Calculate $f'(x)$

$$f(x) = 7^x$$

Problem 2:



$$\frac{d}{dx}(a^x) = \ln(a) \cdot a^x$$

$$f(x) = 7^x \quad a = 7$$

$$f'(x) = \ln(7) \cdot 7^x$$

$$f'(x) = 1.94 \cdot 7^x$$

Problem 3:



Problem 3: Calculate $f'(x)$

$$f(x) = \sqrt[3]{x^7}$$

Exercise: Calculate the derivative



$$\frac{d}{dx} m_{\sqrt{x^n}} = \frac{d}{dx} \left(x^{\frac{n}{m}} \right) = \frac{n}{m} x^{\frac{n}{m} - 1}$$

$$f(x) = \sqrt[3]{x^7}$$

$$f(x) = x^{7/3}$$

$$f'(x) = \frac{7}{3} x^{7/3 - 1}$$

$$f'(x) = \frac{7}{3} x^{\frac{7-3}{3}} = \frac{7}{3} x^{4/3} = \frac{7}{3} \sqrt[3]{x^4}$$



QUESTIONS?
