

Basic Concepts of Differential Equations

What makes an equation a differential equation?

$$x^2 - 3x + 3 = 0$$

$$\sin x + \cos x = 0$$

$$x + y = 7$$

$$x \frac{dy}{dx} + y = 0$$

What changed?
A derivative appeared.

What Is a Differential Equation?

Variables + Derivative(s) = Differential Equation

$$x(dy/dx) + y = 0$$

Independent variable

x

Derivative

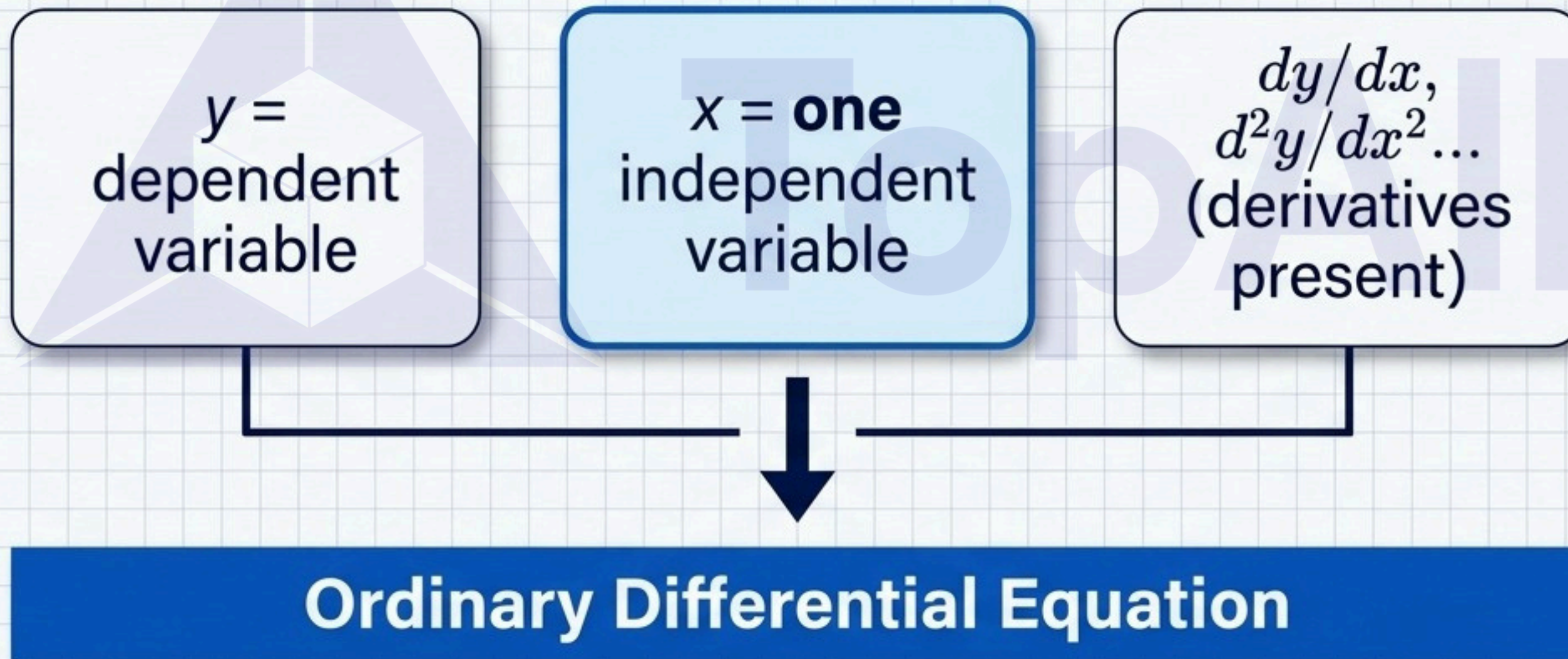
dy/dx

Dependent variable

y

What Does “Ordinary” Mean?

A differential equation involving derivatives with respect to **only one** independent variable is an ordinary differential equation.





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$$E=mc^2$$



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Know the Notation

$$\frac{dy}{dx} = y'$$

1st Order

$$\frac{d^2y}{dx^2} = y''$$

2nd Order

$$\frac{d^3y}{dx^3} = y'''$$

3rd Order

$$\frac{d^n y}{dx^n} = y^{(n)}$$

nth Order

→ Derivative order progression →

Differential Equation or Not?

$$x^2 - 3x + 3 = 0$$

Logic: Derivative present? NO

Ordinary equation

$$x\left(\frac{dy}{dx}\right) + y = 0$$

Logic: Derivative present? YES

Differential equation

$$\frac{d^2y}{dx^2} + y = 0$$

Logic: Derivative present? YES

Differential equation

$$\sin x + \cos x = 0$$

Logic: Derivative present? NO

Ordinary equation

Basic Concepts in One Frame

Key Facts

- A differential equation must contain derivative(s).
- y is usually the dependent variable.
- x is the independent variable.
- Condition: Only ONE independent variable = Ordinary Differential Equation.

Notation Quick Reference

$y' \rightarrow$ 1st derivative

$y'' \rightarrow$ 2nd derivative

$y''' \rightarrow$ 3rd derivative

$y^{(n)} \rightarrow$ nth derivative

Final memory line: First recognise the derivative. Then classify the equation.



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