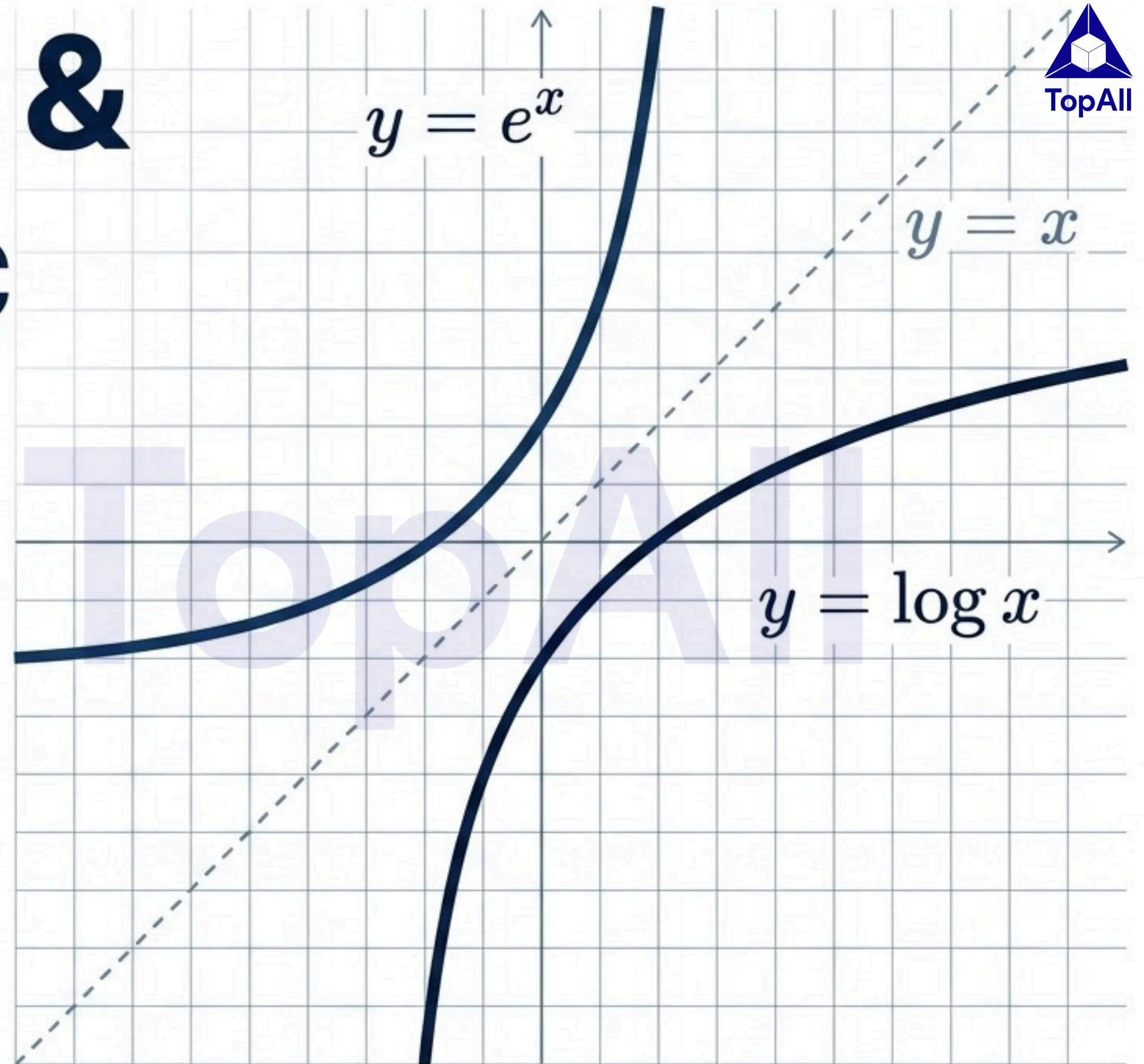


Exponential & Logarithmic Functions

Two inverse functions that power modern calculus.



What Is an Exponential Function?

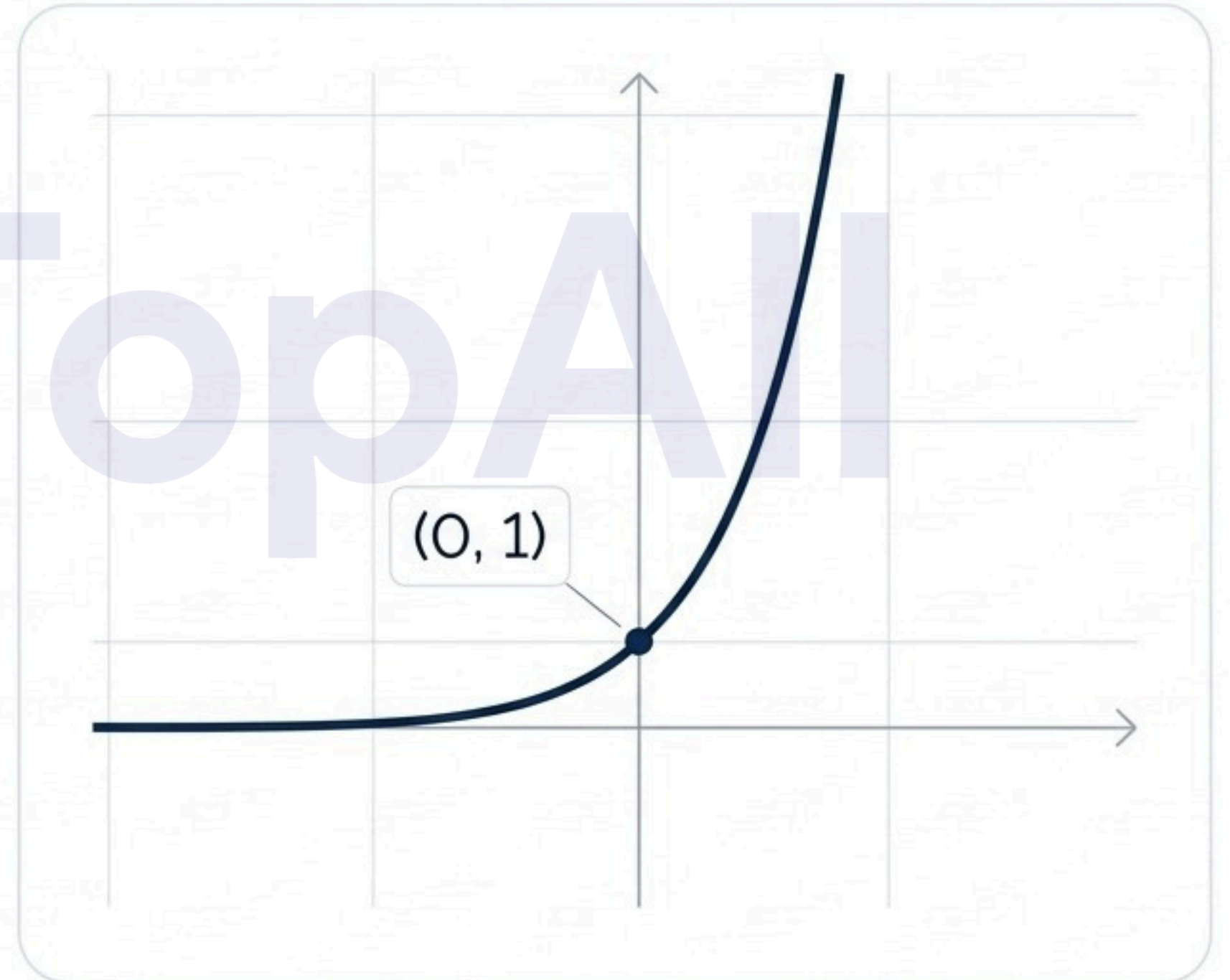
$$y = b^x \quad (b > 1)$$

Domain: **$\mathbf{R}$**

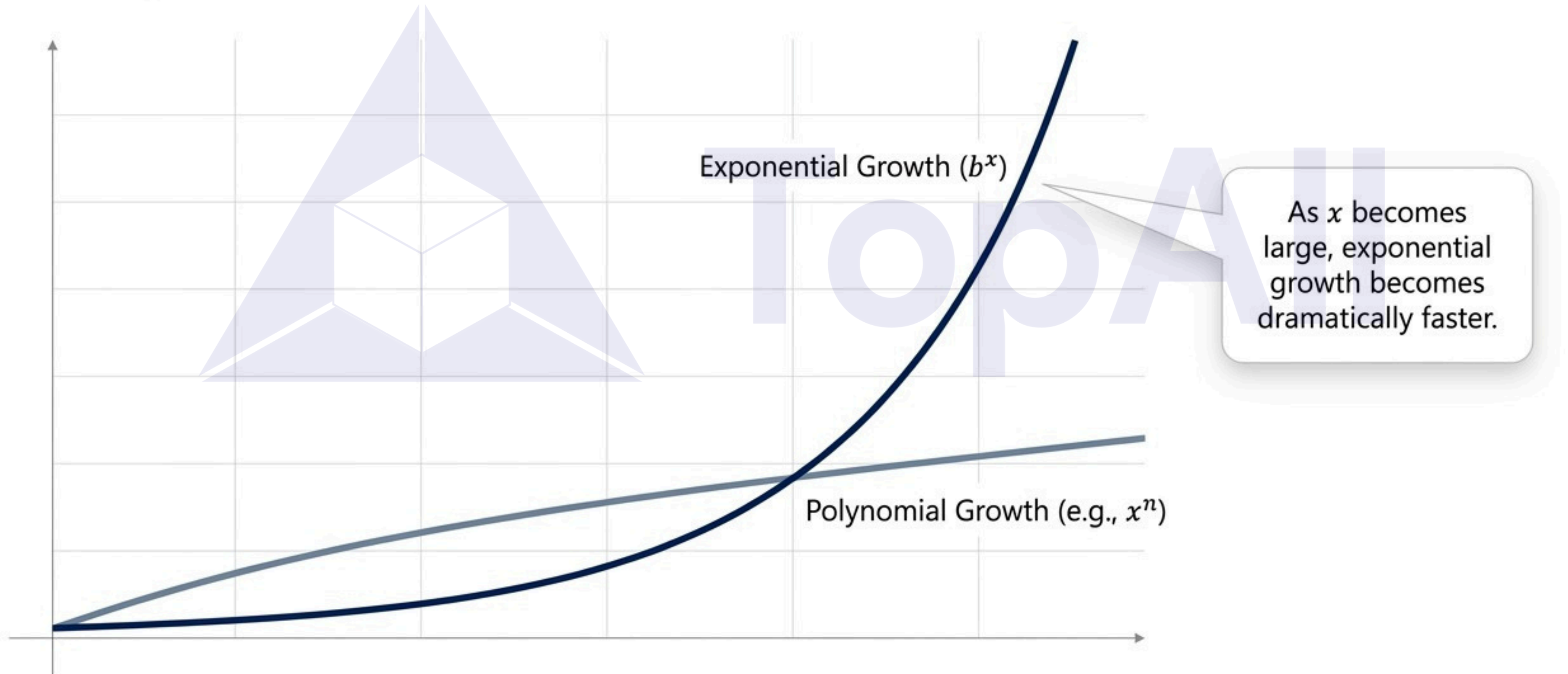
Range: **$\mathbf{R}^+$**

Passes through: **$(0, 1)$**

Behavior: **Ever increasing**



Exponential Growth Outruns Polynomial Growth





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Let's Test Them Now.**

$$E=mc^2$$



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Logarithm Reverses Exponentiation

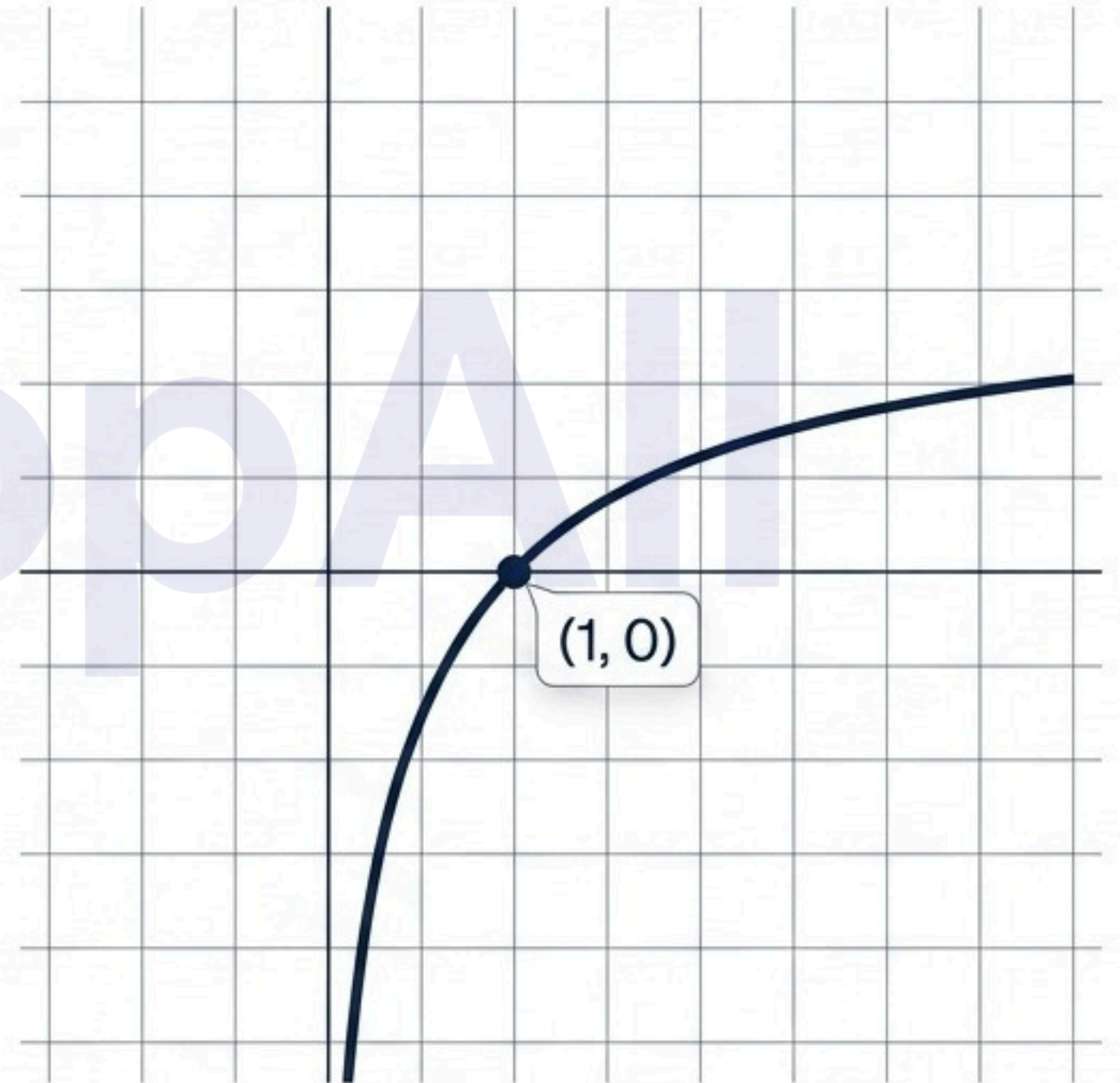
$$\log_b a = x \Leftrightarrow b^x = a$$

Domain: $\mathbf{R^+}$

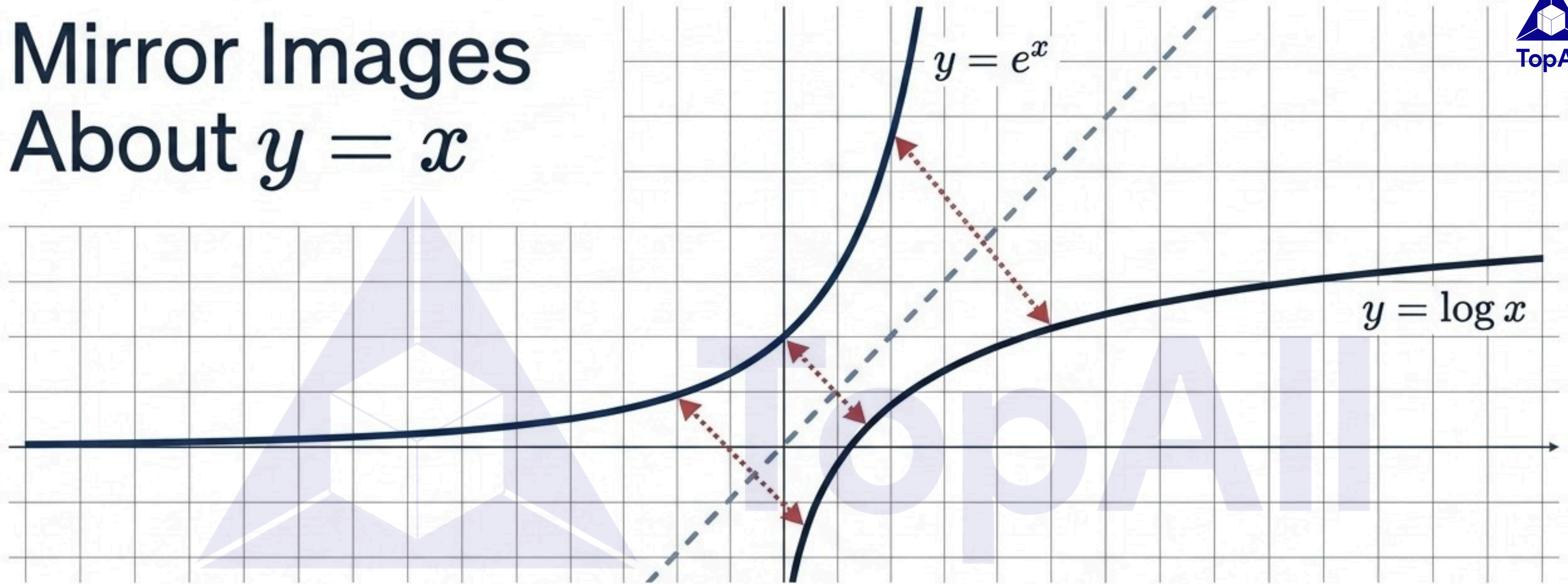
Range: $\mathbf{R}$

Passes through: **(1, 0)**

Behavior: **Ever increasing**



Mirror Images About $y = x$



Exponential

Domain: $\mathbf{R} \rightarrow$ Range: $\mathbf{R}^+$

Logarithm

Domain: $\mathbf{R}^+ \rightarrow$ Range: $\mathbf{R}$

Four Rules to Know

Change of Base

$$\log_a p = \frac{\log_b p}{\log_b a}$$

Product Rule

$$\log_b(pq) = \log_b p + \log_b q$$

Power Rule

$$\log_b(p^n) = n \log_b p$$

Quotient Rule

$$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$$

Two Essential Derivatives

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

The function that is its own derivative.

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

Condition: $x > 0$

Check Before You Simplify

Is $e^{\log x} = x$ true for every real x ?

No. Only for $x > 0$.

Because $\log x$ must be defined in the exponent.

Exponential $\leftrightarrow$ Logarithm

1. Inverse functions (Mirror images across $y=x$)
2. Domain / Range swap exactly
3. Essential derivative formulas tied to their specific domains



You've Learned the Theory.

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