$$y = e^x$$

$$\frac{dy}{dx} = e^x$$

$$f(x) = a^x$$

$$= e^{\ln a \cdot \bigotimes}$$

$$= e^{x \cdot \ln a}$$

$$\Rightarrow f'(x) = e^{x \cdot \ln a} \cdot \ln a$$

$$= a^x \cdot \ln a$$

$$\frac{d}{dx}(e^{5x}) = e^{5x} \cdot 5$$

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

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

$$\frac{d}{dx}(e^x) = e^x \qquad \longrightarrow \qquad \frac{d}{dx}(\ln x) = ?$$

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

$$y = \ln x$$

$$\longleftrightarrow \quad e^y = x$$

$$e^y \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{e^y} = \frac{1}{x} \quad /\!/$$

$$\left|\; \frac{d(e^x)}{dx} = e^x \right.$$

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

$$y = \log_a x$$

$$\longleftrightarrow \quad a^y = x$$

$$a^y \ln a \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{a^y \ln a}$$
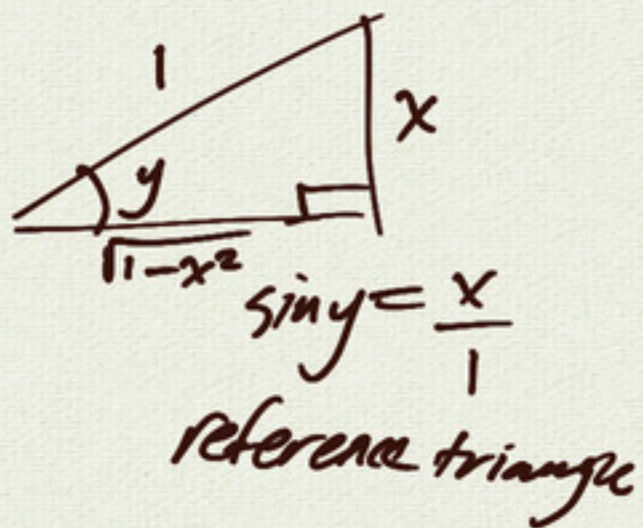
$$= \frac{1}{x \ln a} \quad /\!/$$

$$y = \sin^{-1} x$$

$$\xleftarrow{\quad} \boxed{\sin y = x} \xrightarrow{\quad}$$

$$\cos y \frac{dy}{dx} = 1$$

implicit
diff

$$\frac{dy}{dx} = \frac{1}{\cos y} = \frac{1}{\sqrt{1-x^2}}$$

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

$$\sin y = \frac{x}{1}$$

reference triangle

example:

$$f(x) = \sin^{-1}\left(x^4 + 2^x\right)$$

$$\Rightarrow f'(x) = \frac{1}{\sqrt{1-(x^4+2^x)}} \cdot \left(4x^3 + 2^x \ln 2\right)$$
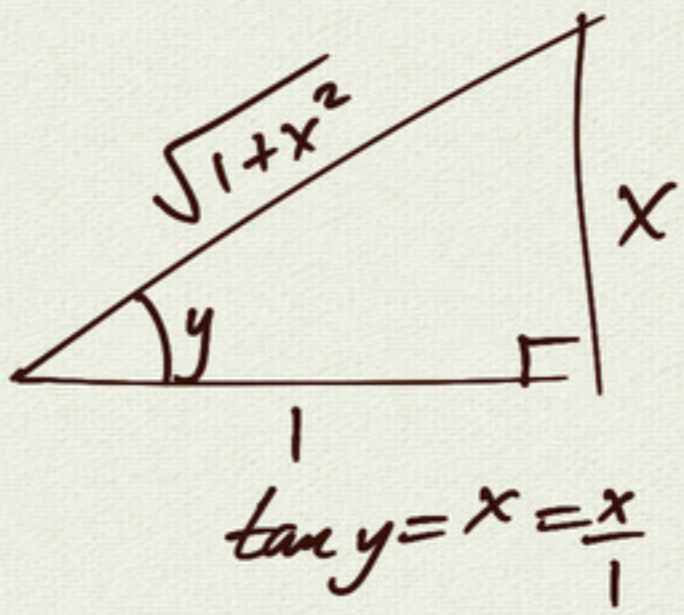
$$y = \tan^{-1} x$$

$$\longleftrightarrow \boxed{\tan y = x}$$

$$\sec^2 y \, \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{\sec^2 y}$$

$$= \cos^2 y$$

$$\boxed{\frac{dy}{dx} = \frac{1}{1+x^2}}$$

$$\tan y = x = \frac{x}{1}$$

example:

$$g(x) = \tan^{-1}\left(\cos\left(x^5 + 5^x\right)\right)$$

$$\implies g'(x) = \frac{1}{1 + \cos^2\left(x^5 + 5^x\right)} \cdot \left(-\sin\left(x^5 + 5^x\right)\right) \cdot \left(5x^4 + 5^x \ln 5\right)$$