

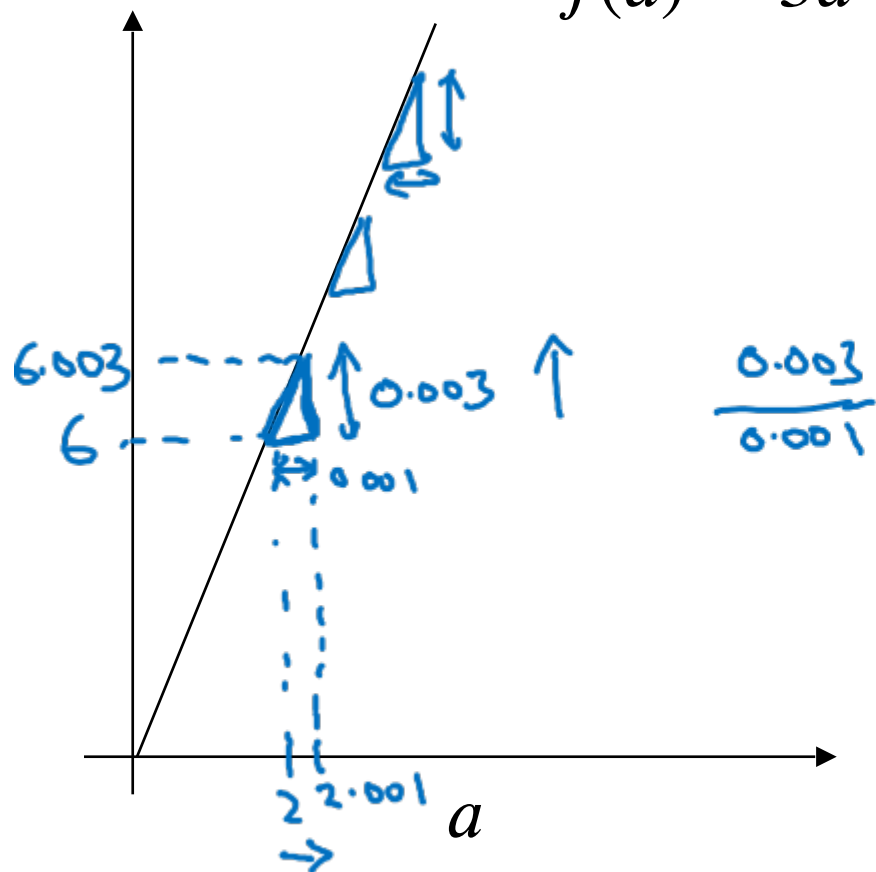


deeplearning.ai

Basics of Neural Network Programming Derivatives

Intuition about derivatives

$$f(a) = 3a$$



$$\frac{0.003}{0.001}$$

height
width

$$\begin{aligned} \rightarrow a=2 & & f(a) &= 6 \\ a=2.001 & & f(a) &= 6.003 \end{aligned}$$

→ slope (derivative) of $f(a)$
at $a=2$ is 3

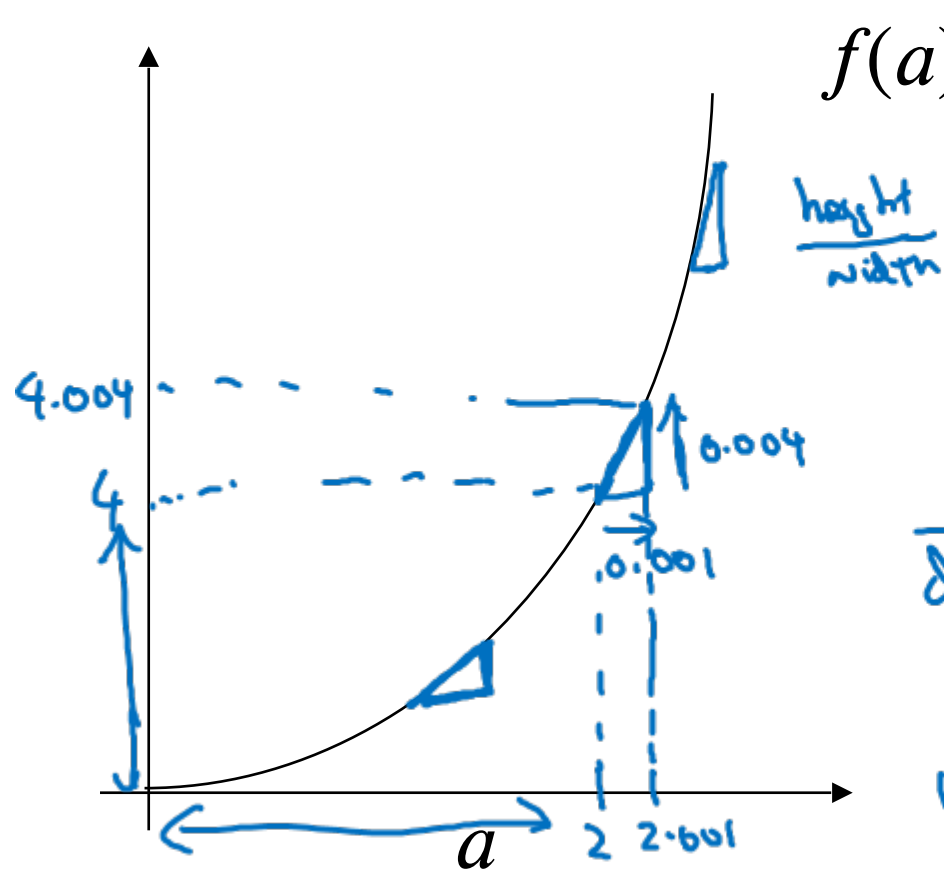
$$\begin{aligned} \rightarrow a=5 & & f(a) &= 15 \\ a=5.001 & & f(a) &= 15.003 \end{aligned}$$

slope at $a=5$ is also 3

$$\frac{df(a)}{da} = 3 = \frac{d}{da} f(a)$$

0.001 ←
0.000000001
0.0000000001

Intuition about derivatives



$$f(a) = a^2$$

$$\frac{d}{da} a^2 = 2a$$

$$0.001$$

$$(2a) \times 0.001$$

$$0.001 \leftarrow$$

$$0.000000...01 \leftarrow$$

$$a=2 \quad f(a)=4$$

$$a=2.001 \quad f(a) \approx 4.004$$

$$\text{slope (derivative) of } f(a) \text{ at } a=2 \text{ is } 4.$$

$$\boxed{\frac{d}{da} f(a) = 4} \text{ when } \boxed{a=2}.$$

$$a=5 \quad f(a)=25$$

$$a=5.001 \quad f(a) \approx 25.010$$

$$\boxed{\frac{d}{da} f(a) = 10} \text{ when } \boxed{a=5}$$

$$\frac{d}{da} f(a) = \frac{d}{da} a^2 = \boxed{2a}$$

More derivative examples

$$f(a) = a^2$$

$$\frac{d}{da} f(a) = \frac{2a}{4}$$

$$a = 2$$

$$f(a) = 4$$

$$a = 2.001$$

$$f(a) \approx 4.004$$

$$f(a) = a^3$$

$$\frac{d}{da} f(a) = \frac{3a^2}{3 \times 2^2 = 12}$$

$$a = 2$$

$$f(a) = 8$$

$$a = \underline{2.001}$$

$$f(a) \approx \underline{8.012}$$

$$f(a) = \log_e(a)$$

$$\ln(a)$$

$$\frac{d}{da} f(a) = \frac{1}{a}$$



$$\frac{d}{da} f(a) = \boxed{\frac{1}{2}}$$

$$a = 2$$

$$f(a) \approx 0.69315$$

$$a = \underline{2.001}$$

$$\underline{f(a) \approx 0.69365}$$

$$\downarrow$$

$$0.0005$$

$$\swarrow$$

$$\underline{0.0005}$$