



deeplearning.ai

# Setting up your optimization problem

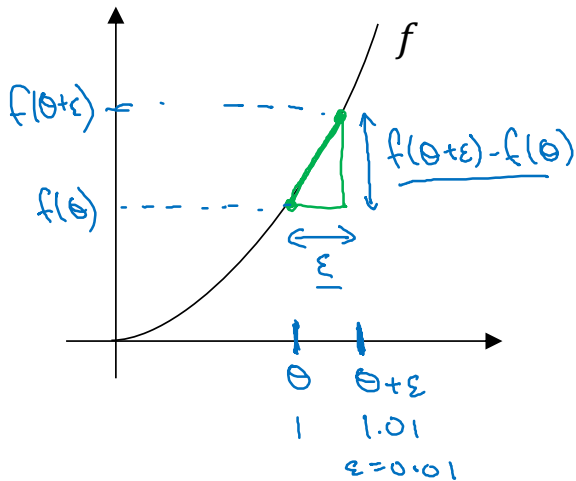
---

## Numerical approximation of gradients

导数公式...

# Checking your derivative computation

I  $\rightarrow \underline{f(\theta) = \theta^2}$   
 $\theta \in \mathbb{R}.$



$$g(\theta) = \frac{d}{d\theta} f(\theta) = f'(\theta)$$

$g(\theta) = 3\theta^2$

$g(\theta) = 3 \cdot (1)^2 = 3$   
 when  $\theta = 1$

$$\frac{f(\theta + \epsilon) - f(\theta)}{\epsilon} \approx g(\theta)$$

$$\frac{(1.01)^3 - 1^3}{0.01} = 3.0301 \approx 3$$

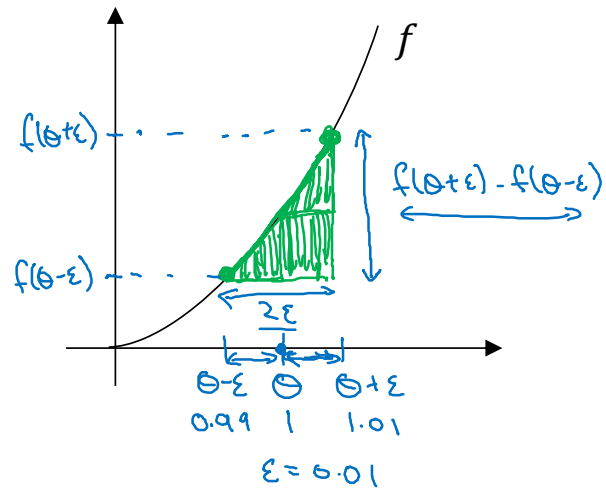
Annotations for the calculation above:

- $3.1$  and  $3.2$  are written below  $3.0301$ .
- $0.0301$  is written below  $3.0301$ .
- An arrow points from the  $3$  in  $3.0301$  to the  $3$  in the approximation  $\approx 3$ .
- An arrow points from the  $0.01$  in the denominator to the  $0.0301$  in the numerator.

$\theta = 1$   
 $\theta + \epsilon = 1.01$

# Checking your derivative computation

$$\underline{f(\theta) = \theta^3}$$



$$\left[ \frac{f(\theta + \epsilon) - f(\theta - \epsilon)}{2\epsilon} \approx \underline{g(\theta)} \right]$$

$$\frac{(1.01)^3 - (0.99)^3}{2(0.01)} = 3.0001 \approx 3$$

$$g(\theta) = 3\theta^2 = 3$$

approx error: 0.0001

(prev slide: 3.0301. error: 0.03)

---

重作

$\left\{ f'(\theta) = \lim_{\epsilon \rightarrow 0} \frac{f(\theta + \epsilon) - f(\theta - \epsilon)}{2\epsilon} \right.$	$O(\epsilon^2)$ $0.01$ $0.0001$		$\frac{f(\theta + \epsilon) - f(\theta)}{\epsilon}$	<p>error: <math>O(\epsilon)</math></p> <p style="text-align: center;">0.01</p>
$\uparrow$			$\uparrow \quad \uparrow$	