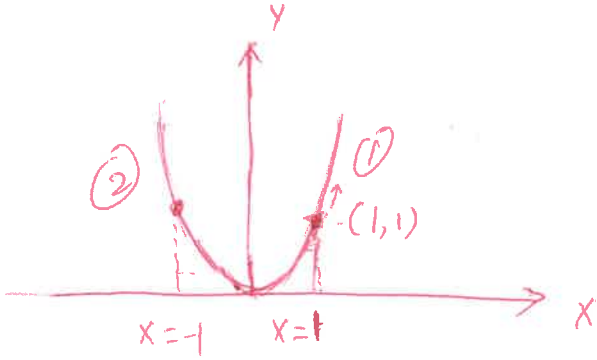

$y = x^2$

Gradient / First derative

$$\frac{d(y)}{d(x)} = \frac{d(x^2)}{dx} = 2 \cdot x$$

$$\text{derative} = \frac{\Delta y}{\Delta x}$$

derative $= 2 \cdot (x)$

when $x = 1 \Rightarrow$ derative $= 2 \times 1 = 2$.

We use a learning rate $\eta = 0.1$

use Gradient x learning rate to control the weight Update

derative $\times \eta = 2 \times (0.1) = 0.2$.

Gradient Descent learning.

① movement is controlled by: $-$derative $\times \eta = -2 \times (0.1) = -0.2$.

Current $x = 1$

Next $\Rightarrow$ $x = 1$ $-$ derative $\times \eta = 1 - 0.2 = 0.8$.

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② derative $= 2 \cdot (x) \Rightarrow 2 \cdot (-1) = -2$.
$x = -1$

movement is controlled by: $-$derative $\times \eta = -1 \times (-2) \cdot 0.1 = 0.2$.

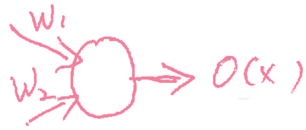
Current $x = -1$

Next Location $x = -1$ $-$derative $\times \eta = (-1) + 0.2 = -0.8$

① $f(w) = \frac{1}{2}(d-w)^2$

$$\frac{d(f(w))}{d(w)} = \frac{1}{2} \times 2(d-w) \cdot \frac{d(d-w)}{dw} = \frac{1}{2} \times 2(d-w) \cdot (-1)$$

$$= -(d-w)$$

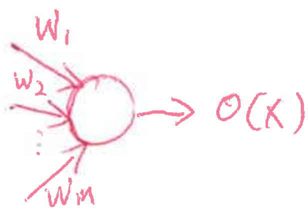
② 

$$f(w_1, w_2) = \frac{1}{2}(d-(w_1 \cdot x_1 + w_2 \cdot x_2))^2$$

$$\frac{\partial f(w_1, w_2)}{\partial w_1} = \frac{\partial (d-(w_1 \cdot x_1 + w_2 \cdot x_2))^2}{\partial w_1} = (d-(w_1 \cdot x_1 + w_2 \cdot x_2)) \cdot \frac{\partial (d-(w_1 x_1 + w_2 x_2))}{\partial w_1}$$

$$= (d-(w_1 \cdot x_1 + w_2 \cdot x_2)) \cdot (-x_1)$$

$$= -(d-(w_1 \cdot x_1 + w_2 \cdot x_2)) \cdot x_1$$

③ 

$$f(w_1, w_2, \cdots w_m) = \frac{1}{2}(d-(w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots + w_m \cdot x_m))^2$$

$$\frac{\partial (f(w_1, w_2, \cdots w_m))}{\partial w_i} = \frac{\partial \left\{ \frac{1}{2}(d-(w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots w_m \cdot x_m))^2 \right\}}{\partial w_i}$$

$$= (d-(w_1 \cdot x_1 + w_2 \cdot x_2 + \cdots w_m \cdot x_m)) \cdot (-x_i)$$

$$= -\left(d - \sum_{k=1}^{m} w_k \cdot x_k\right) \cdot x_i$$

④

$$f(w_1, w_2, \cdots w_m) = \frac{1}{2}\sum_n \left(d(n) - \sum_{i=1}^{m} w_i \cdot x_i(n) \right)^2$$

$$= \frac{\partial f(w_1, w_2, \cdots w_m)}{\partial w_j} = \frac{\partial \left[\frac{1}{2}\sum_n \left(d(n) - \sum_{i=1}^{m} w_i \cdot x_i(n) \right)^2 \right]}{\partial w_j}$$

$$= \frac{\partial \left[\frac{1}{2}\left(d(1) - \sum_{i=1}^{m} w_i \cdot x_i(1) \right)^2 \right]}{\partial w_j} + \frac{\partial \left[\frac{1}{2}\left(d(2) - \sum_{i=1}^{m} w_i \cdot x_i(2) \right)^2 \right]}{\partial w_j} + \cdots$$

$$\cdots \frac{\partial \left[\frac{1}{2}\left(d(n) - \sum_{i=1}^{m} w_i \cdot x_i(n) \right)^2 \right]}{\partial w_j}$$

$$\Downarrow$$

$$= -\left(d(1) - \sum_{k=1}^{m} w_k \cdot x_k(1) \right) \cdot x_j(1) - \left(d(2) - \sum_{k=1}^{m} w_k \cdot x_k(2) \right) \cdot x_j(2) + \cdots$$

$$- \left(d(n) - \sum_{k=1}^{m} w_k \cdot x_k(n) \right) \cdot x_j(n).$$

$$= -\sum_n \left(d(n) - \sum_{k=1}^{m} w_k \cdot x_k(n) \right) \cdot x_j(n).$$