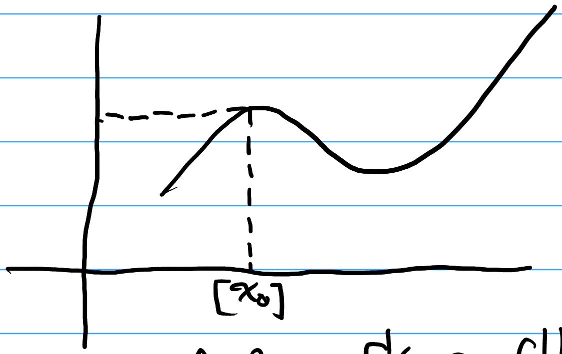
$$f(x_0+\delta) = f(x_0) + \frac{\delta}{1!} f'(x_0) + \frac{\delta^2}{2!} f''(x_0) + \cdots$$



$f(x_0)$ $f'(x_0)$ $f''(x_0)$

By Taylor series expansion

$$f(x_0+\delta) \simeq f(x_0) + \frac{\delta}{1!} f'(x_0)$$

-ve dir^n of gradient

$\omega^{(k)}$ $E(\omega^{(k)})$ let $\delta = -\eta\left(\frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}\right)$

$$\omega^{(k+1)} = \omega^{(k)} + \delta = \left(\omega^{(k)} - \eta \frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}\right)$$

$$E(\omega^{(k+1)}) = E(\omega^{(k)}) - \eta \frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}} \frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}$$

$$E(\omega^{(k+1)}) = E(\omega^{(k)}) - \eta\left(\frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}\right)^2$$

Taylor's theorem can be applied only if

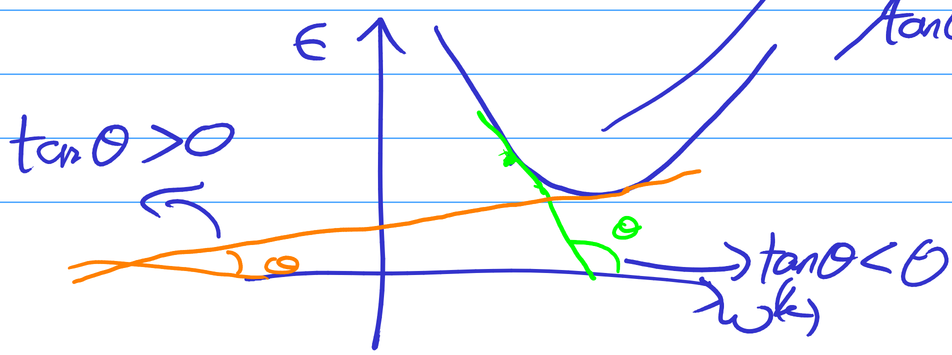
$-\eta \frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}$ is small

$$\Rightarrow \left[E(\omega^{(k+1)}) < E(\omega^{(k)})\right]$$

in both cases $\omega^{(k+1)}$ is closer to minima

$$\tan\theta = \frac{\partial E}{\partial \omega}\Big|_{\omega=\omega^{(k)}}$$

$\Rightarrow$



$$E(w^{(k+1)}) = E(w^{(k)}+\delta)$$

$$= E\left(w^k + -\eta \frac{\partial E}{\partial w}\Big|_{w=w^k}\right)$$

$$= E(w^k) - \left(\eta \frac{\partial E}{\partial w}\Big|_{w=w^k}\right)\left(E'(w^k)\Big|_{w=w^k}\right)$$

$$\frac{\partial E}{\partial w_k}\Big|_{w=w^k}$$

$$\Rightarrow E(w^{(k+1)}) < E(w^k)$$