after first itration we have:

$\Delta w^1 = \eta(t^1 - \hat{y}^1)x^1$ which $\hat{y}^i = \text{sign}(w \cdot x^i)$ in each itration

then in next itration we have:

$$\Delta w^2 = \eta(t^2 - \hat{y}^2)x^2$$

$$= \eta(t^2 - \text{sg}(w^1 \cdot x^2))x^2$$

$$= \eta(t^2 - \text{sg}((w^0 + \Delta w^1) \cdot x^2))x^2$$

$$= \eta(t^2 - \text{sg}((w^0 + \eta(t^1 - \hat{y}^1)x^1)x^2))x^2$$

$$= \eta(t^2 - \text{sg}((w^0 + \eta(t^1 - \text{sg}(w^0 \cdot x^1))x^1) \cdot x^2))x^2 \quad *$$

if we consider $w^0 = 0$ the $*$ will simplify to:

$$\Delta w^2 = \eta(t^2 - \underbrace{\text{sg}(\eta(t^1 - 1)x^1 \cdot x^2)}_{**})x^2$$

~~η is not~~ η does not change the function $**$ since $\eta > 0$

So we have:

$$\Delta w^2 = \eta(t^2 - \text{sg}((t^1 - 1)x^1 \cdot x^2))x^2$$

So the scaler η only affect the scale of Δw^2 and not the direction the same can be prove for Δw^i by induction $\boxed{\equiv}$