Quadric Machine HW January 17th, 2025

The table has:

inputs x, y, xy, x^2, y^2

weights $(wx, wy \ldots)$ changes $(\Delta wx, \Delta wy \ldots)$

Bias (bias) change ΔBias

Net value, Output, Target

Inputs (x, y) combinations (xy, x^2, y^2) in the first few columns

Initialize Weights:

Weights $(wx, wy \ldots)$ are initially set to 0,

change of weights $(\Delta wx, \Delta wy \ldots)$ set to 0.

Compute Weighted Sum (net):

$$net = (wx \cdot x) + (wy \cdot y) + (wxy \cdot xy) + (wx^2 + x^2) + (wy^2 + y^2) + Bias$$

note use weights and bias values for each row of x, y, xy, x^2, y^2 to calculate net

Activation Output:

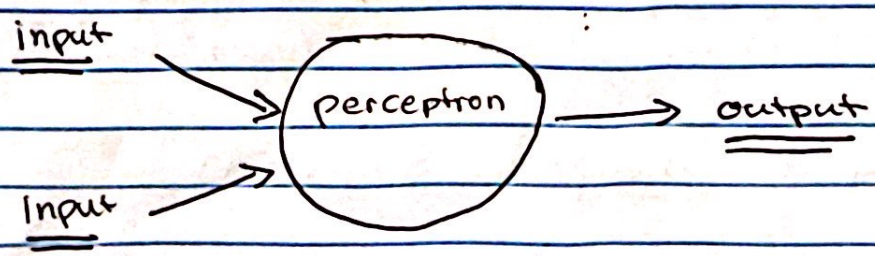
$$Output := \begin{cases} 1 & net \geq threshold \\ 0 & otherwise \end{cases}$$

• Compare Output with Target:

Output matches Target
↳ if not, adjust weights and bias

Δwx = learning rate • (Target - Output) • x
Δwy = learning rate • (Target - Output) • y
Δwxy, Δwx^2, Δwy^2, Δ bias

Update weights $wx = wx + \Delta wx$
$wy = wy + \Delta wy$



5 input weights (x, y, xy, x^2, y^2) + bias weight
output 2 if net > Θ, else Φ

Learning rate 'c' of .5 and intial weights of Φ
$\Delta w_i = c(t-z)x_i$

x	y	xy	x^2	y^2	Δwx	Δwy	Δwxy	Δwx^2	Δwy^2	Δbias	net	Output	Target

Row 1:

Inputs
- x = 0
- y = 0.4
- xy = 0 * 0.4 = 0
- $x^2 = 0^2 = 0$
- $y^2 = (0.4)^2 = 0.16$

Initial weights:
- wx = 0
- wy = 0
- wxy = 0
- $wx^2 = 0$
- $wy^2 = 0$
- bias = 0

Compute net:

$$net = (wx \cdot x) + (wy \cdot y) + (wxy \cdot xy) + (wx^2 \cdot x^2) + (wy^2 \cdot y^2) + bias$$

$$net = (0 \cdot 0) + (0 \cdot 0.4) + (0 \cdot 0) + (0 \cdot 0) + (0 \cdot 16) + 0 = 0$$

Output: $z = 0$ ($net \leq 0$)

Compare Target: target = 0, output = 0 no need update