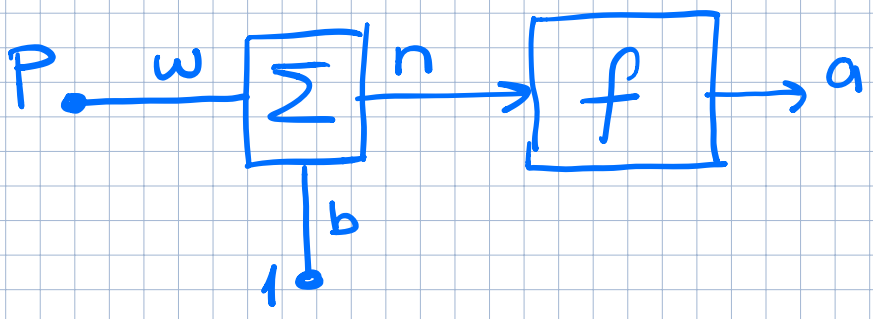
NÖRON MODELİ:

Tek girişli Nöron

* Ağırlık (weight)
* Eşik (bias)
* Tranfer (aktivasyon) fonk.

Tek girişli Nöron modeli:



Nöron cıkışı $\Rightarrow a = f(p.w + b)$

ÖRN: $w = 3 \quad p = 2 \quad b = -1.5$

$$a = f(3.2 + (-1.5))$$

$$a = f(4.5)$$

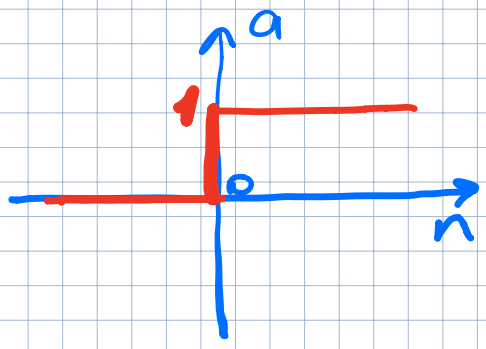
L2

$w \Rightarrow$ ağırlık $\Rightarrow$ öğrenme bilg.

$w, b \Rightarrow$ nümerik değerlerdir.
öğrenme kuralları ile değiştirilir.

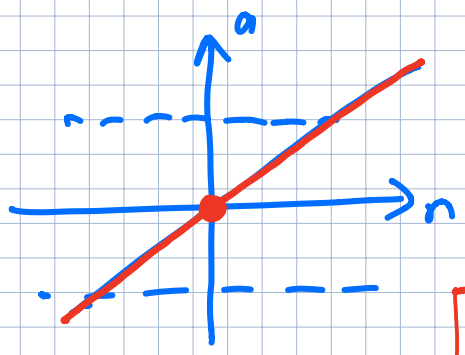
Aktivasyon Fonksiyonu:

Hardlim:



$a = hardlim(n)$

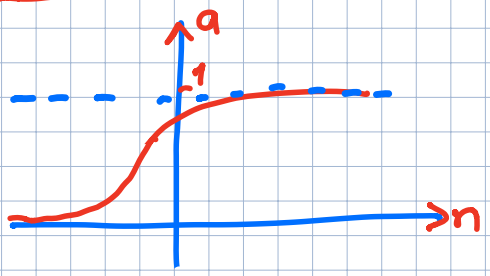
Lineer:



$a = n$

ADALINE (Adaptive Linear Element)
"Lineer" aktivasyon fonksiyonu kullanırlar.

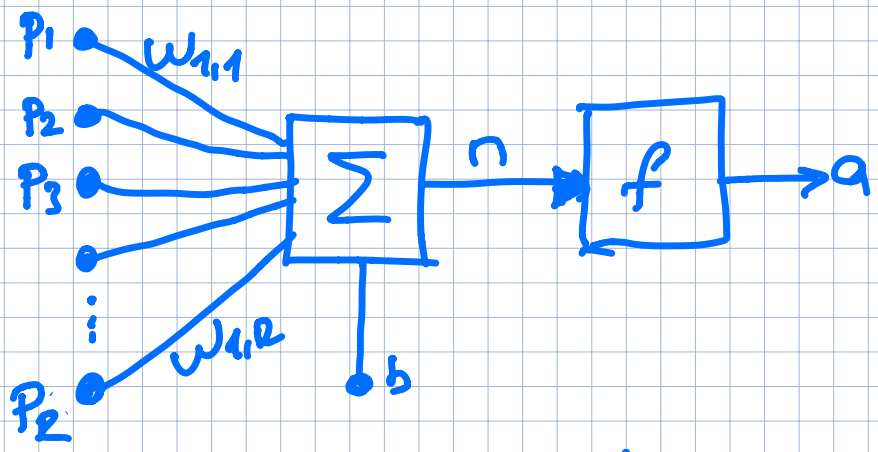
log-sigmoid:



$$a = \text{logsig}(n)$$

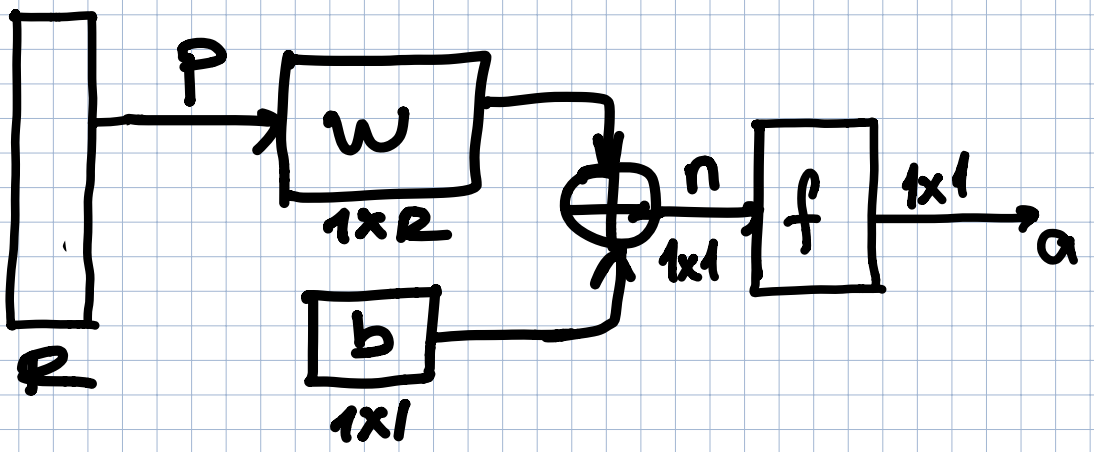
$$a = \frac{1}{1+e^{-n}}$$

ÇOKLU GİRİŞLİ NÖRON

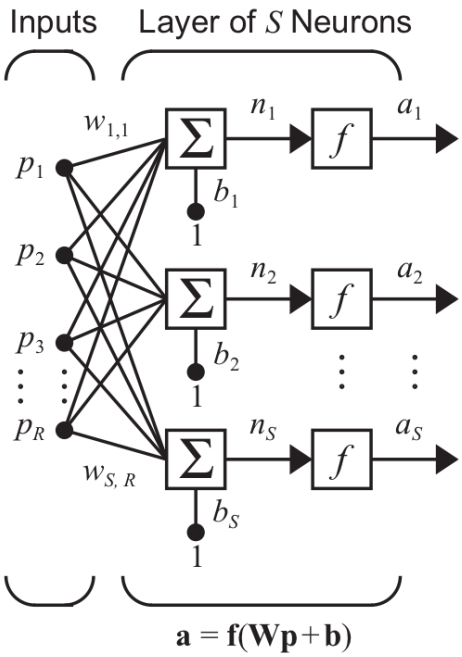


$$a = f(Wp + b)$$

$$n = w_{1,1} \cdot p_1 + w_{1,2} p_2 + \cdots + w_{1,R} p_R + b$$



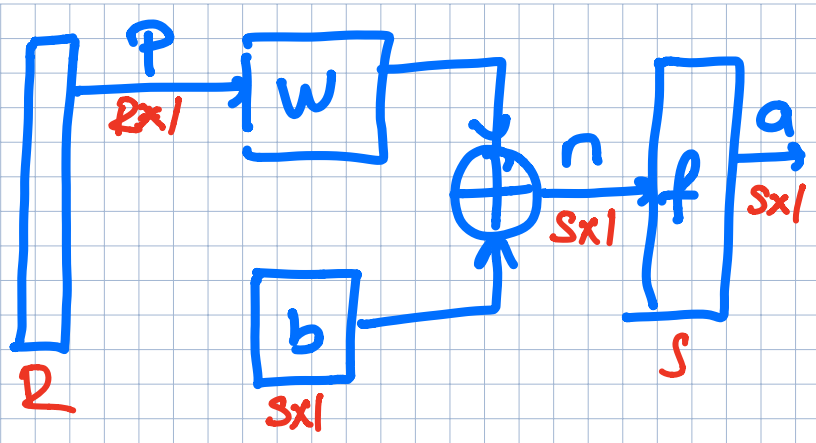
S adet nöron bir katman



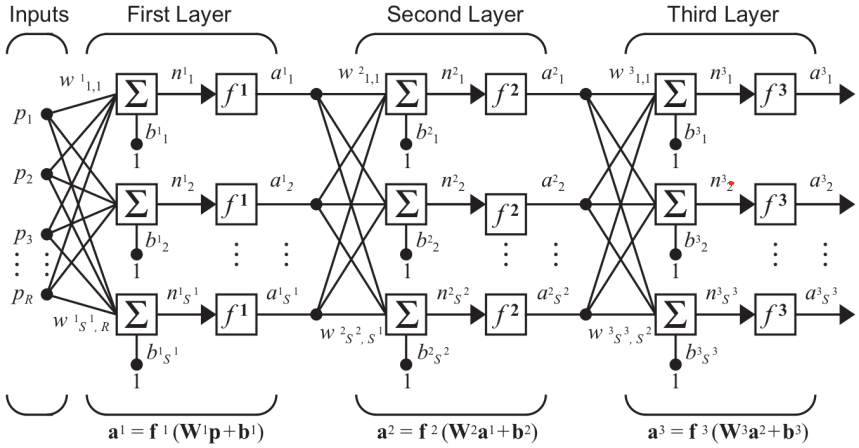
Katman sayısı 2 veya 3 ile sınırlıdır.

Derin öğrenmede durum farklıdır.

$$W = \begin{bmatrix} w_{1,1} & w_{1,2} & \cdots & w_{1,R} \\ & & & \\ w_{S,1} & & & w_{S,R} \end{bmatrix}$$

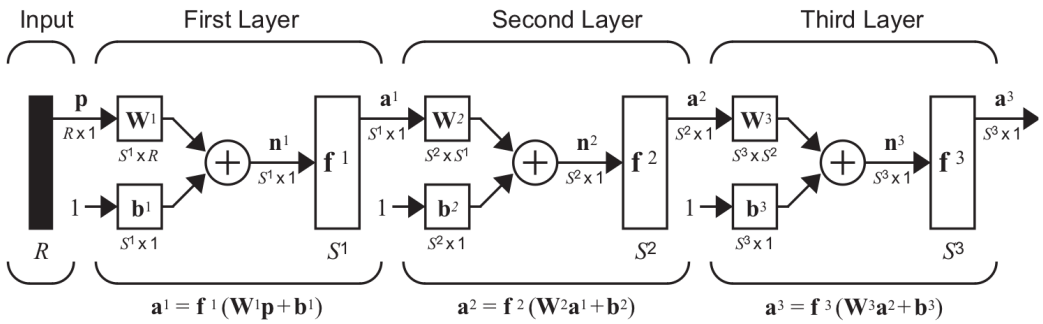


$$a = f(Wp + b)$$



$$a^3 = f^3(W^3 f^2(W^2 f^1(W^1 p + b^1) + b^2) + b^3)$$

— 3 katmanlı ağ yapısı —



$$a^3 = f^3(W^3 f^2(W^2 f^1(W^1 p + b^1) + b^2) + b^3)$$

Şu ana kadar şu üç yapıyı gördük: 17

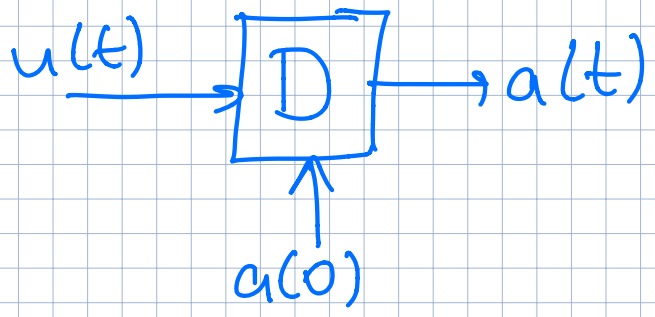
1) ADALINE (1 giriş 1 çıkış)

2) Çok girişli tek çıkışlı

3) Çok katmanlı yapı (MLP)

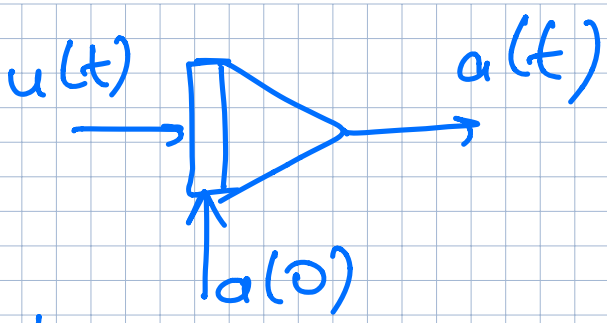
Yinelemeli Ağ Yapısı
(Recurrent Network)

Gecikme:



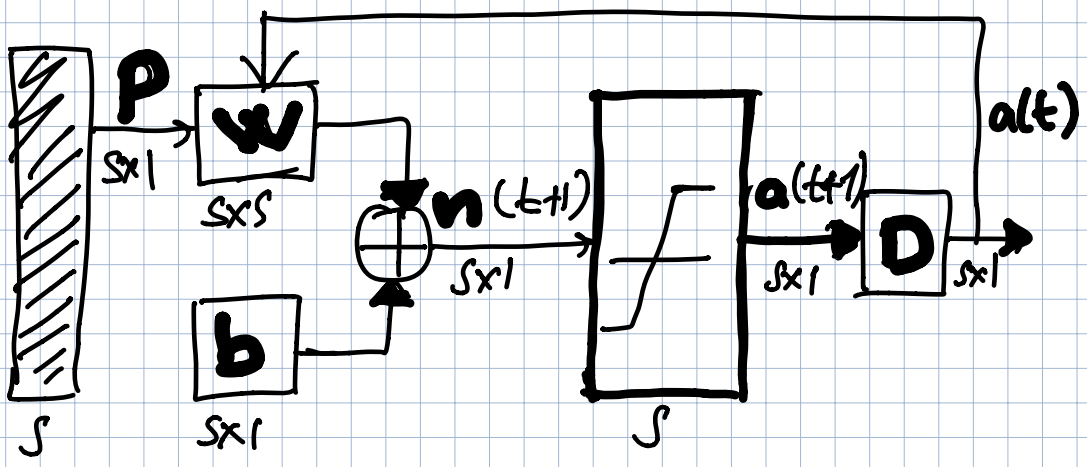
$$a(t) = u(t-1)$$

Integrator:



$$a(t) = \int_0^t u(\tau)\,d\tau + a(0)$$

başlangıç durumu



$a(0) = p$

$a(t+1) = satlins(Wa(t)+b)$

$a(1) = satlins(Wa(0)+b)$

$a(2) = satlins(Wa(1)+b)$

$a(3) = \ldots\ldots$

PERSEPTRON ÖĞRENME KURALI

1) Danışmanlı (supervised)

2) Danışmansız (unsupervised)

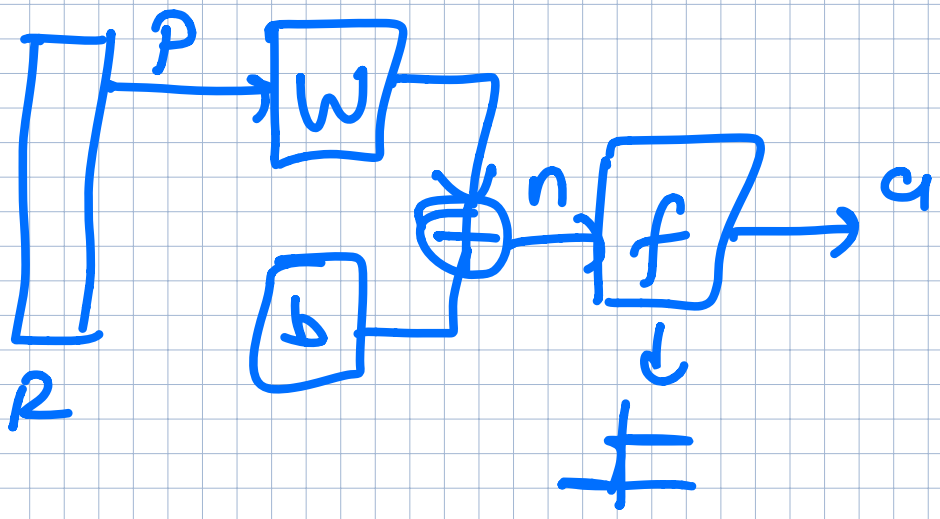
3) Destekli (reinforcement)

Danışmanlı öğrenme:

$\{p_1, t_1\}$ $\{p_2, t_2\}$ ---- $\{p_q, t_q\}$

giriş çıkış

Perceptron (Algılayıcı) Ağı:



$$a = \text{hardlim}(Wp + b)$$

Karar Sınırı (decision boundary)

$$n = {}_1W^T p + b$$

$$= w_{1,1} p_1 + w_{1,2} p_2 + b = 0$$

ÖRNEK:

$w_{1,1} = 1 \qquad w_{1,2} = 1 \qquad b = -1$

Karar sınırı;

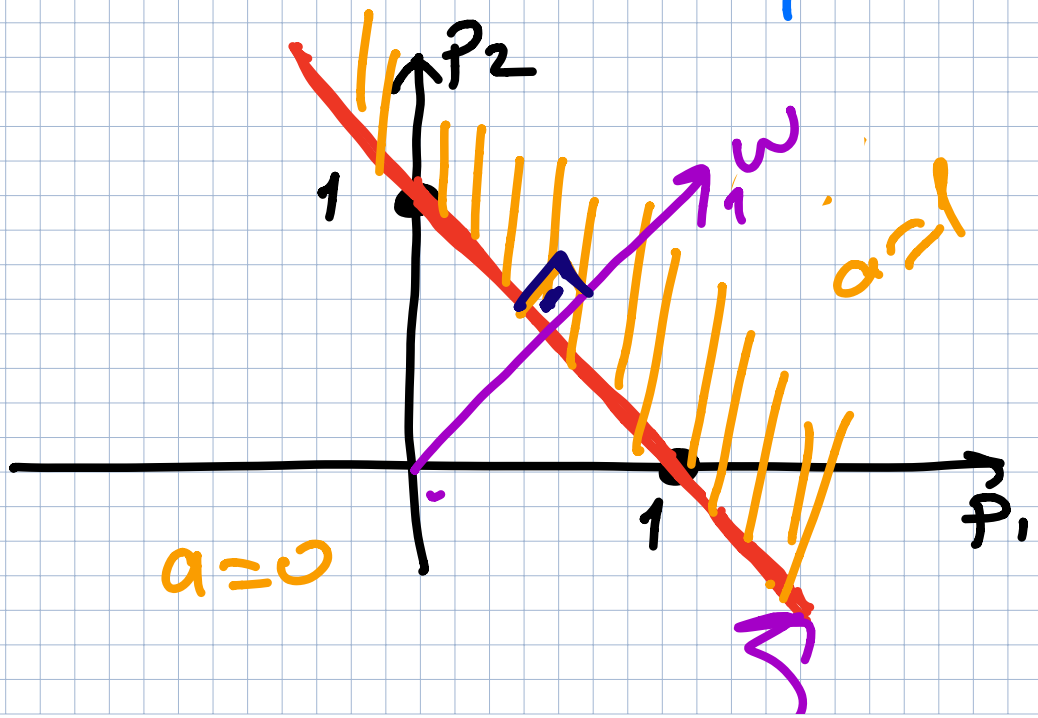
$$n = W^T p + b$$

$$= w_{1,1} p_1 + w_{1,2} p_2 + b = 0$$

$$= p_1 + p_2 - 1 = 0$$

$$p_1 = 0 \Rightarrow p_2 = -\frac{b}{w_{1,2}} = -\frac{-1}{1} = 1$$

$$p_2 = 0 \Rightarrow p_1 = -\frac{-1}{1} = 1$$



$_1W^Tp+b=0$

— 2 girişli 1 perseptron için karar sınırı —

Her zaman W, karar sınırı ile ortogonal' dir.

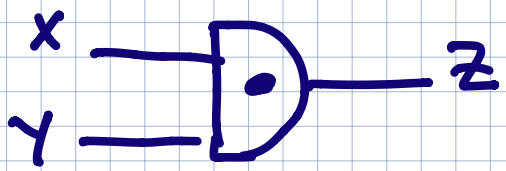
ÖRNEK: "VE" kapısı

- Dijital elektronik
- mantıksal işlemler
- Boole Cebiri:
- 0 ve 1 değerleri

VE	(AND)
VEYA	(OR)
DEĞİL	(NOT)

AYRICALI VEYA (EXOR)

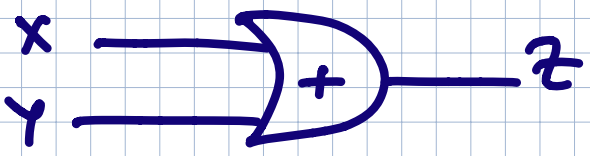
AND Kapısı:



$Z = X \cdot Y$

X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

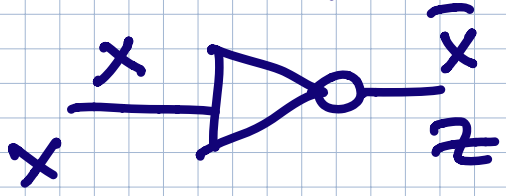
OR Kapısı:



$Z = X + Y$

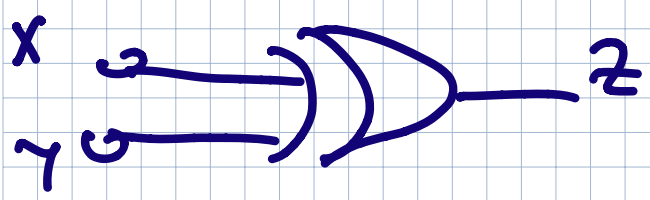
X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

NOT Kapısı:



X	Z
0	1
1	0

Exo2 Logisim



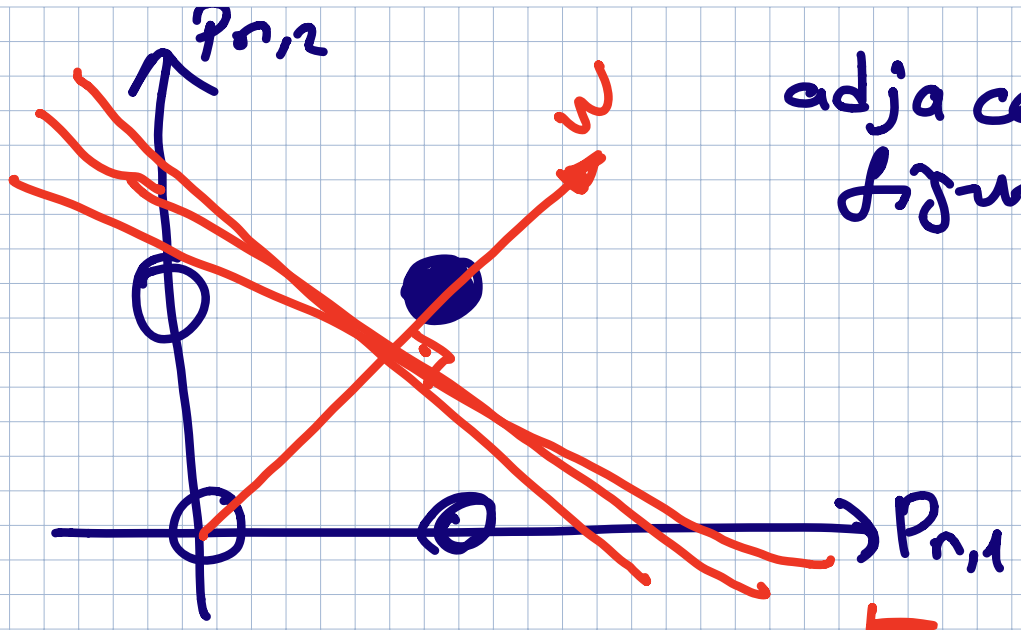
x	y	z
0	0	0
0	1	1
1	0	1
1	1	0

$$P_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix} \quad t_1 = 0$$

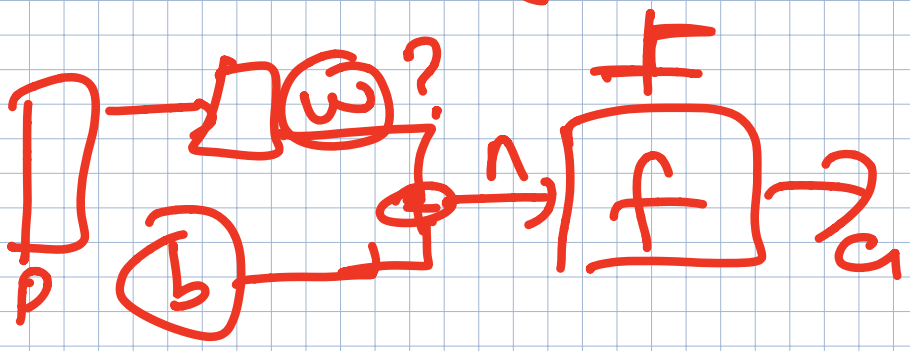
$$P_2 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad t_2 = 0$$

$$P_3 = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \quad t_3 = 0$$

$$P_4 = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \quad t_4 = 1$$



adjacent figure



$$w = \begin{bmatrix} 2 \\ 2 \end{bmatrix} \qquad b = ?$$

$$p = \begin{bmatrix} 1.5 & 0 \end{bmatrix}$$

$$w\,p + b = \begin{bmatrix} 2 & 2 \end{bmatrix} \begin{bmatrix} 1.5 \\ 0 \end{bmatrix} + b = 0$$

$$\boxed{b = -3}$$

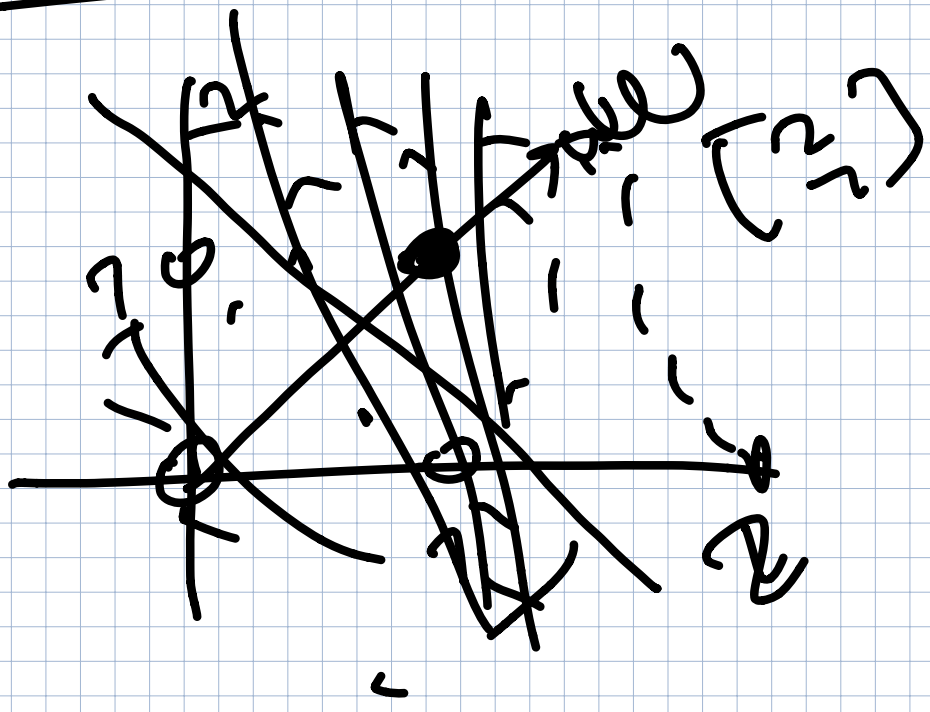
p_2'yi girişe koyalım:

$$a = \text{hardlim}(W^T p_2 + b)$$

$$a = \text{hardlim}\left([2\ 2]\begin{bmatrix}0\\1\end{bmatrix} - 3\right)$$

$$a = \text{hardlim}(-1) = 0$$

$$\left[\begin{bmatrix}1\\0\end{bmatrix}, \begin{bmatrix}1\\1\end{bmatrix}, \begin{bmatrix}0\\0\end{bmatrix}\right]$$



Perceptron Öğrenme Algoritması

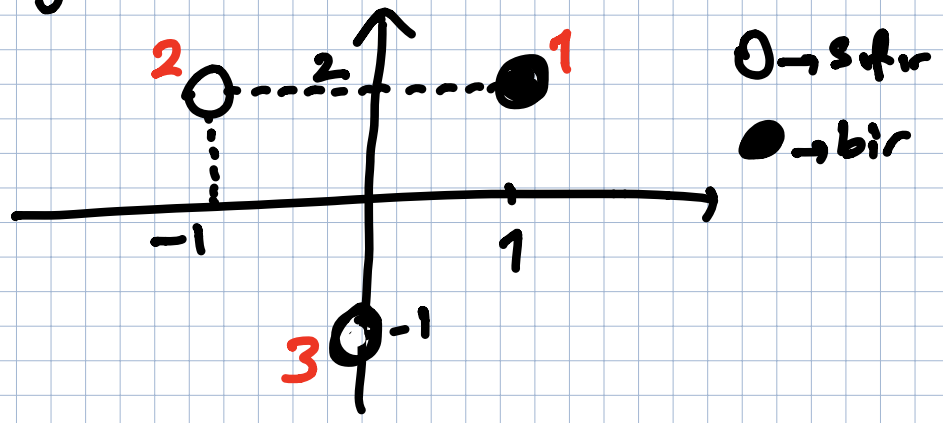
$$\{p_1, t_1\}, \{p_2, t_2\} \cdots \{p_q, t_q\}$$

$$p_1 = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \quad t_1 = 1$$

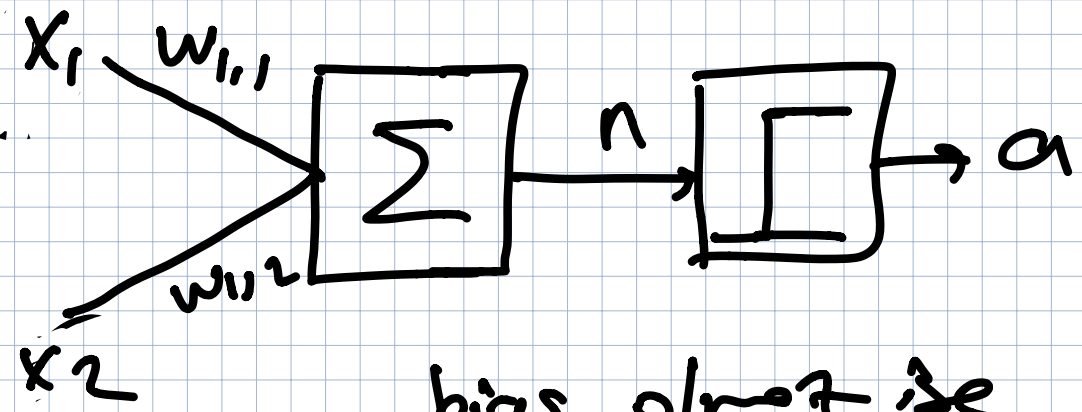
$$p_2 = \begin{bmatrix} -1 \\ 2 \end{bmatrix} \quad t_2 = 0$$

$$p_3 = \begin{bmatrix} 0 \\ -1 \end{bmatrix} \quad t_3 = 0$$

Adjacent Figure



2 girişli , 1 çıkışlı



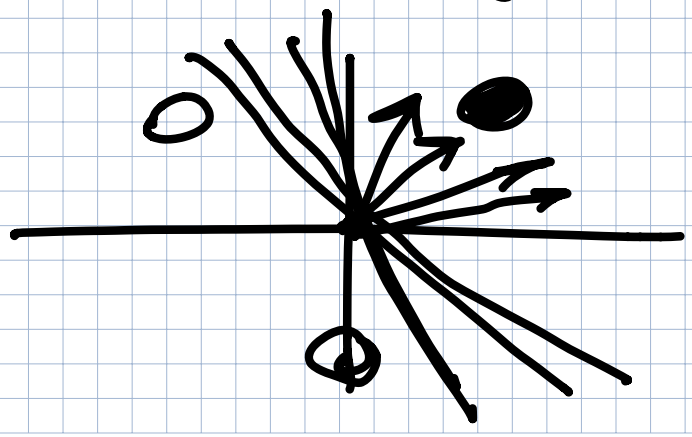
bias olmaz ise

↓

origin

$$p_R = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

$$a = hardlim(wp)$$



Öğrenme Kuralını oluşturmaya başlayalım:

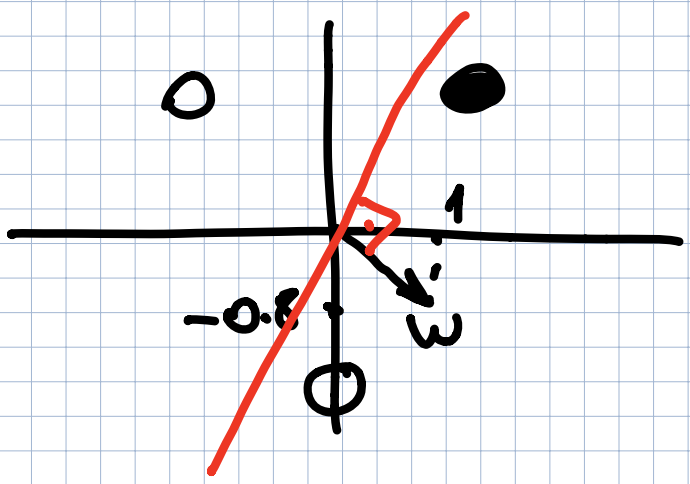
Adım 1: Başlangıç ağırlıklarının seçimi

$$w^T = [1 \quad -0.8]$$

Adım 2: p_1'i ağa verelim.

$$a = \text{hardlim}\left([1 \quad -0.8]\begin{bmatrix}1\\2\end{bmatrix}\right)$$

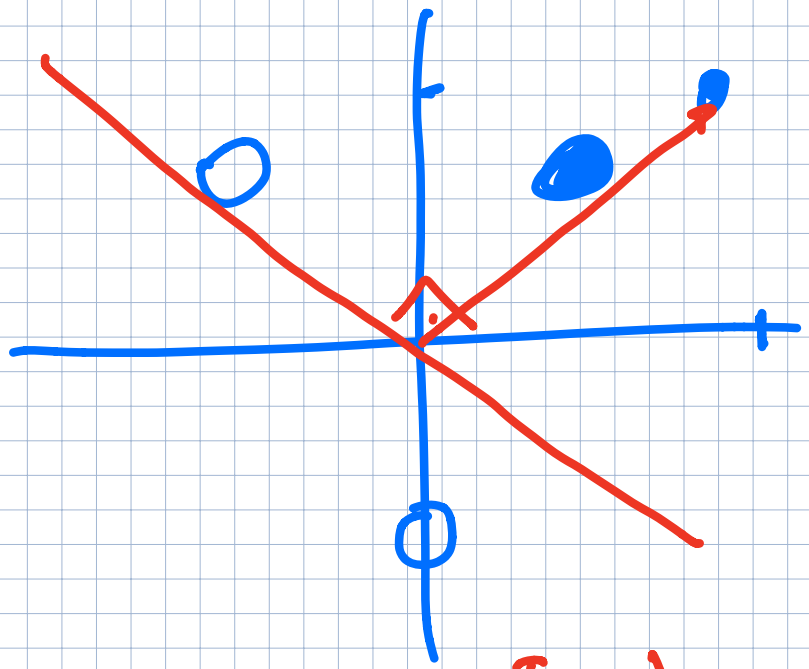
$$a = \text{hardlim}(-0.6) = 0$$



Eğer $t=1$ ve $a=0$

$$w^{yeni} = w^{eski} + p_1$$

$$w^{yeni} = \begin{bmatrix} .1 \\ -0.8 \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 2 \\ 1.2 \end{bmatrix}$$



$$a = hardlim(w^T p_2)$$

$$= hardlim\left([2 \quad 1.2]\begin{bmatrix} -1 \\ 2 \end{bmatrix}\right)$$

$$= hardlim(0.4) = 1$$

Eğer $t=0$ ve $a=1$

$$w^{yeni} = w^{eski} - p$$

$$w^{yeni} = \begin{bmatrix} 2 \\ 1.2 \end{bmatrix} - \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \\ -0.8 \end{bmatrix}$$

$$a = hardlim(w^T p_3)$$

$$= hardlim\left(\begin{bmatrix} 3 & -0.8 \end{bmatrix} \begin{bmatrix} 0 \\ -1 \end{bmatrix} \right)$$

$$= hardlim(0.8) = 1$$

$t=a$ ise $w^{yeni} = w^{eski}$

Perseptron Öğr. Kuralı

$t=1$ ve $a=0 \Rightarrow w^{yeni} = w^{eski} + p$

$t=0$ ve $a=1 \Rightarrow w^{yeni} = w^{eski} - p$

$t=a \Rightarrow w^{yeni} = w^{eski}$

Genelleştirilmiş Perseptron Öğrenme Kuralı:

$$e = t - a$$

$e=1 \Rightarrow w^{yeni} = w^{eski} + p$

$e=-1 \Rightarrow w^{yeni} = w^{eski} - p$

$e=0 \Rightarrow w^{yeni} = w^{eski}$

$$b^{yeni} = b^{eski} + e$$

ÖDEV:

$$P_1 = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix} \quad t_1 = 0$$

$$P_2 = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix} \quad t_2 = 1$$

Perceptron öğrenme kuralını kullanarak sınıflandırmayı gerçekleştiriniz.

$$W = [0.5 \quad -1 \quad -0.5]$$

$$b = 0.5$$

1) El ile 7 iterasyonu hesaplayınız (30p)
2) Program ile gerçekleştirme (70p)