FF N N

Train ➞ W:

area/NW	price-home
10 0,5	
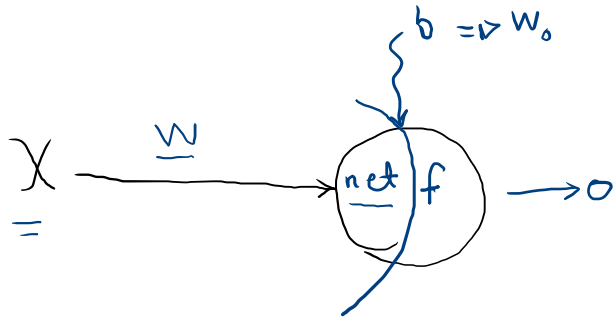
bias

$b \Rightarrow W_0$

$X \xrightarrow{\quad W \quad}$ net f ➞ o

net = WX + b

o = f(net)

net = WX + b
↳ linear!

← mx + b

linear classifier

$y = \underline{w}x + o$

$y = wx + 3$

X_1 اندازه

X_2 رنگ

$\sum$ ◯

activat —

nonlinear.

رنگ

انگور صغ

رنگ

انگور صغ

input layer

act linear
tanh

81 | 9.

Flatten

Dense

P_1 P_2 P_7

P_1 P_2 P_3 ...

P_1
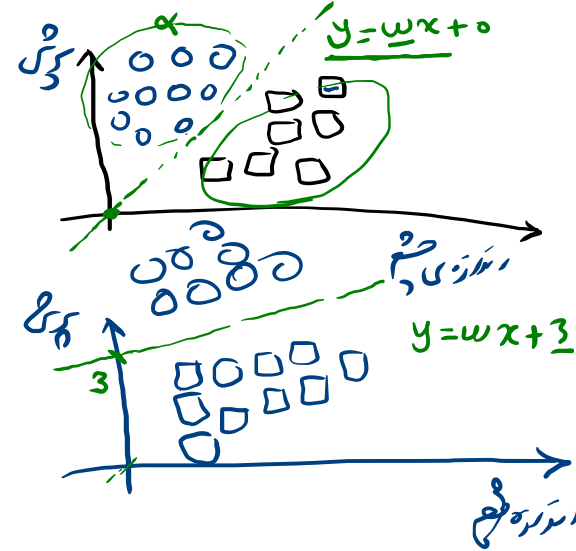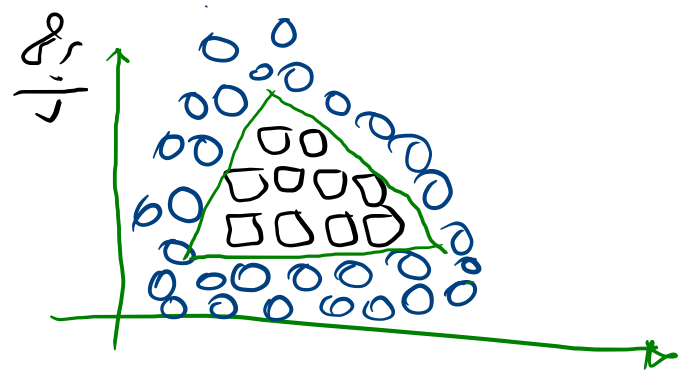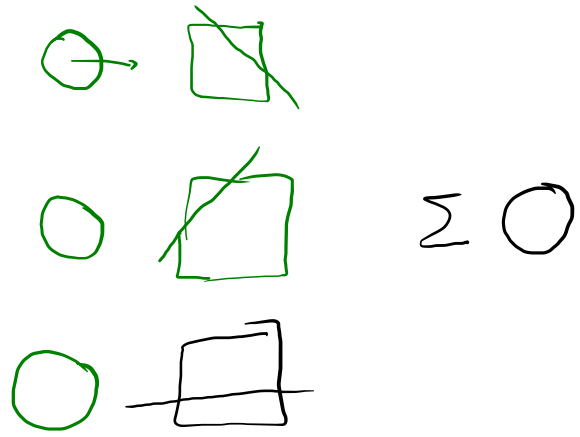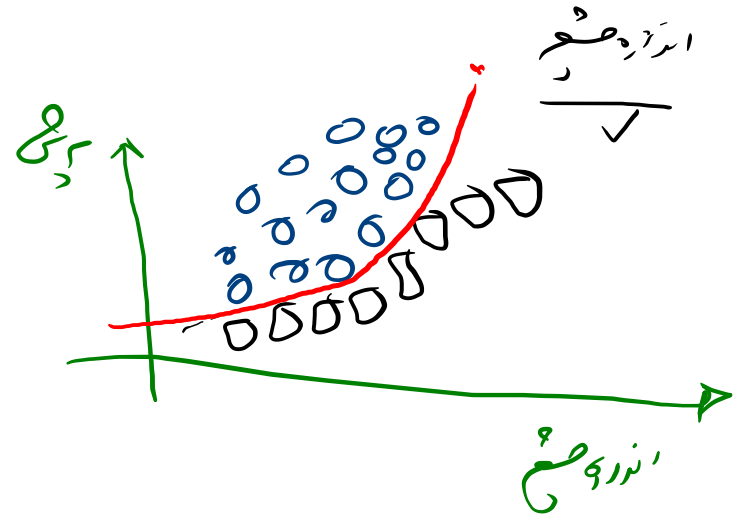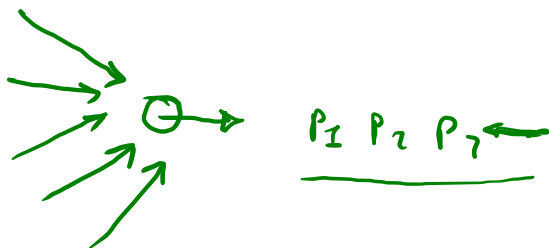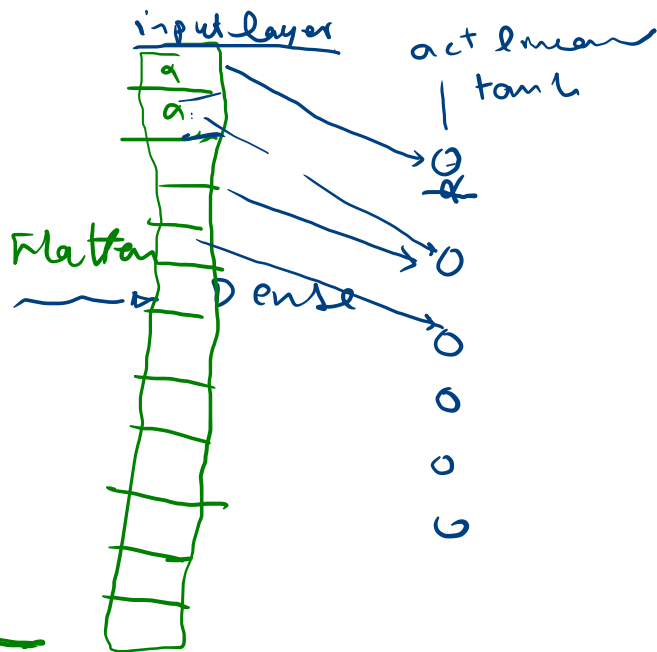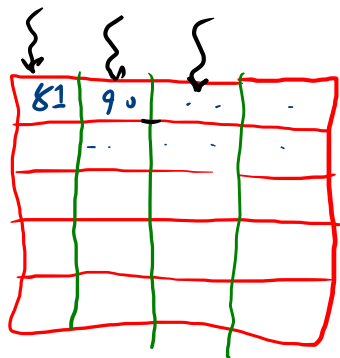
P_1 P_2, P_3 — One class!
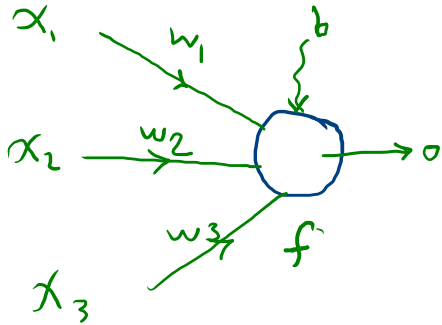
$$net = \sum_{i=1}^{3} w_i \cdot x_i + b$$

$$net = w_1 x_1 + w_2 x_2 + w_3 x_3 + b$$

$$o = f(net)$$

$$net = \sum_{i=0}^{3} w_i \cdot x_i$$

$$w_0 = b$$

$$x_0 = 1$$

MLP

l_0
$n=1$
input

$n=1$
l_1

$n=1$
l_2

$n=1$
l_3

$W^{\boxed{layer}}_{\boxed{dst}\ \boxed{oris}}$

$W^{\boxed{layer}}_{\boxed{dst}\ \boxed{oris}}$

x_1

w^1_{11}

$net^1_1\ o^1_1$

w^2_{11}

$net^2_1\ o^2_1$

w^3_{11}

output

net^3_1 / O^3_1

f_1, b_1

f_2, b_2

f_3, b_3
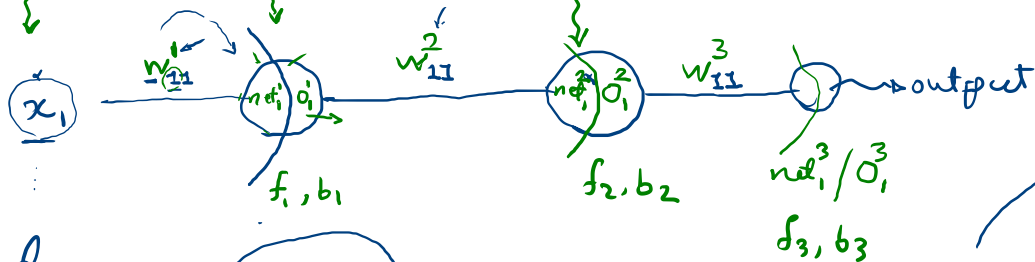
Feed Forward

$$net^1_1 = w^1_{11} X_1 + b_1$$

$$O^1_1 = f_1 (net^1_1)$$

$$net^2_1 = w^2_{11} O^1_1 + b_2$$

$$O^2_1 = f_2 (net^2_1)$$

$$net^3_1 = w^3_{11} O^2_1 + b_3$$

$$output = O^3_1 = f_3 (net^3_1)$$

1

X_1

$.5$

X_2

l_1 l_2 l_3

W_{11}^1 O_1^1 W_{11}^2 O_1^2 W_{11}^3 O_1^3

W_{21}^1 W_{12}^2 W_{11}^3

W_{21}^1 O_2^1 W_{21}^2 b_3, f_3

W_{32}^1 W_{22}^2 O_2^2

b_1, f_1 b_2, f_2
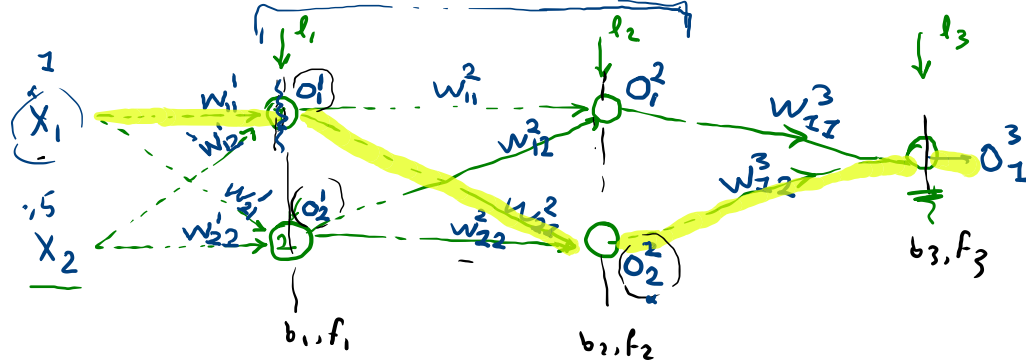
n-Hidden layer $\geqslant 2$

FFNN == Fully connected

$$net_1^1 = W_{11}^1 X_1 + W_{12}^1 X_2 + b_1$$

$$O_1^1 = f_1(net_1^1)$$

$$net_2^2 = W_{21}^2 O_1^1 + W_{22}^2 O_2^1 + b2$$

$$O_2^2 = f_2(net_2^2)$$

$$net_1^3 = W_{11}^3 O_1^2 + W_{12}^3 O_2^2 + b_3$$

$$O_1^3 = f_3(net_1^3)$$
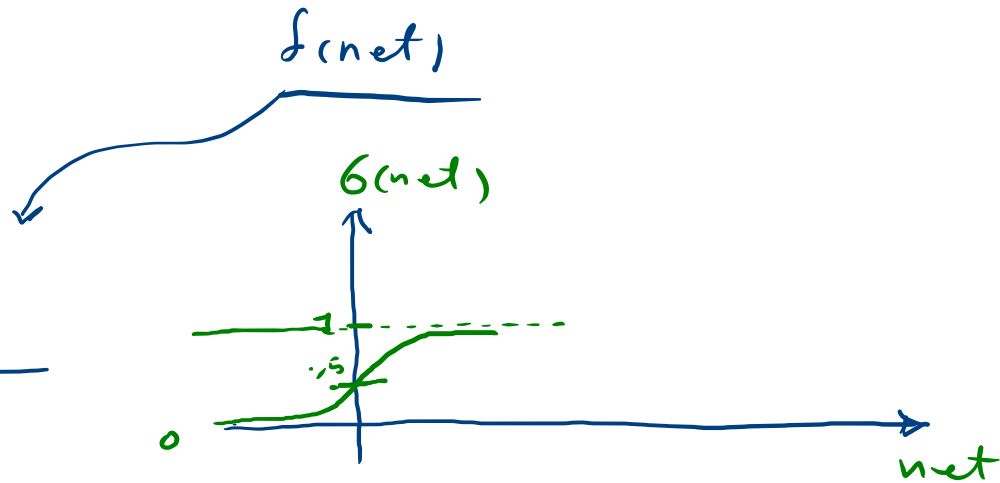
$$output = O_1^3$$

Activation functions

1. Sigmoid

$$\sigma(net) = \frac{1}{1 + e^{-net}}$$

f(net)

6(net)

1

.5

0

net

• در می اخر، output
• دنی که Binary classification دارم !
• خروجی ~ حرف احمالات !

img

سگ بودن یا نبودن !

احتمال سگ بودن !

NN

out

Sigmoid ← ممم ← نقل ← ممم ← 0,3 → شدت !

شدت ! ← 5و
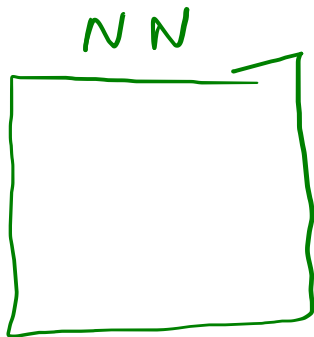
2. Softmax

$$\begin{bmatrix} 1 \\ 4 \\ 5 \end{bmatrix} \text{ softmax} \rightarrow \begin{bmatrix} \square \\ \square \\ \square \end{bmatrix}$$

$$\sigma(X_j) = \frac{e^{X_j}}{\sum\limits_{i} e^{X_i}}$$

$$\frac{e^1}{e^1 + e^4 + e^5} = \frac{e}{e + e^4 + e^5} = \underline{\quad}$$
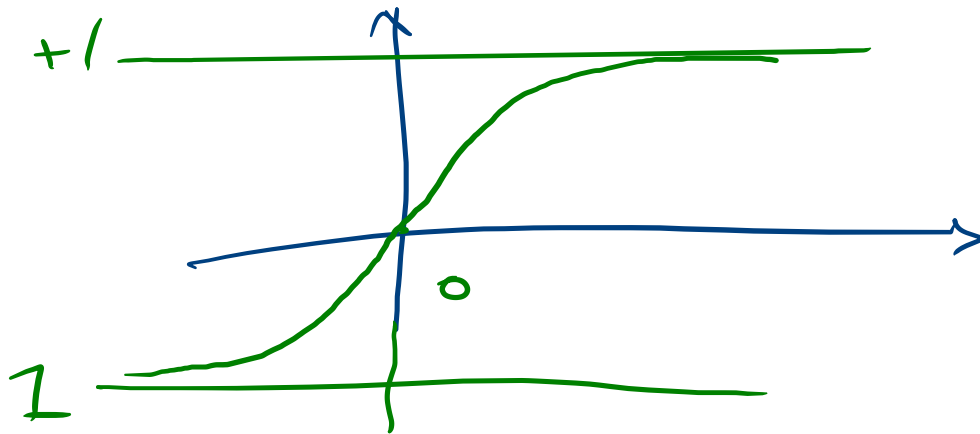
$$\frac{e^4}{e^1 + e^4 + e^5} = \cdots$$

output   مخرجات النموذج

$$\begin{array}{c} \text{تصفير قيم - كبيرة} \\ \hline 3 \end{array}$$

$$\begin{bmatrix} \square \\ \square \\ \square \end{bmatrix} \text{ softmax} \begin{bmatrix} .7 \rightarrow \text{انها قطة} \\ .2 \rightarrow \text{انها كلب} \\ .1 \rightarrow \text{انها طير} \end{bmatrix} \text{جميل!} \leftarrow \text{multiclass classification} \quad \checkmark \text{مهمه}$$

3. $\tanh = \dfrac{\sinh(x)}{\cosh(x)} = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$

+1

0

1
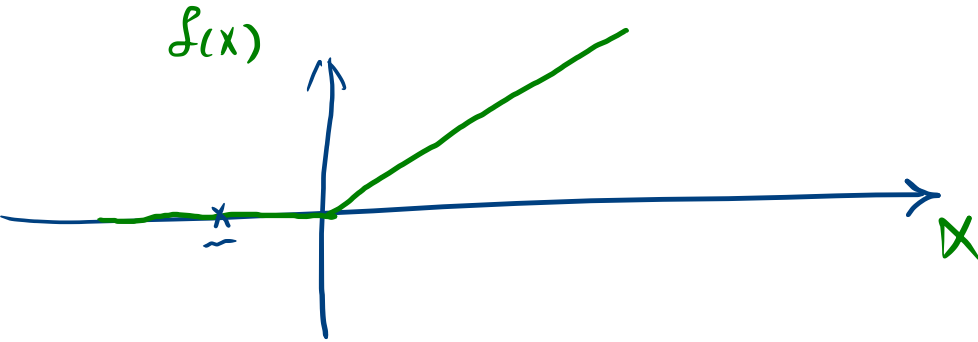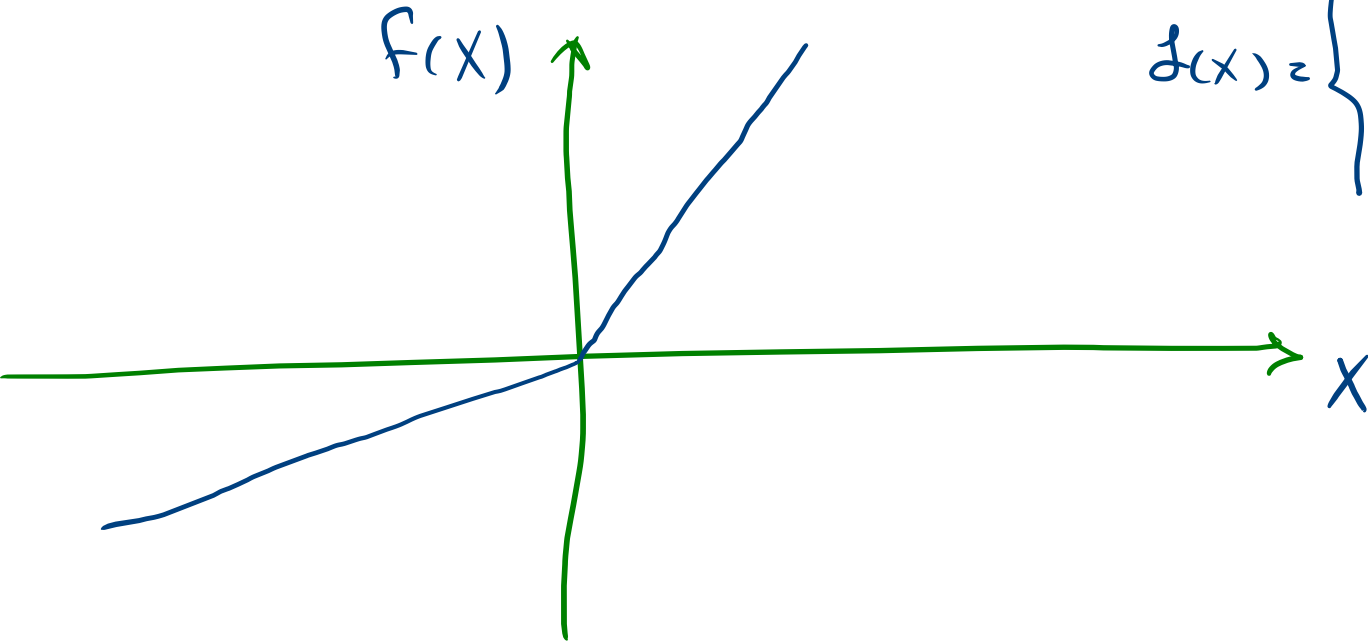
hidden layer

4. Relu

Rectified linear unit

$$f(x) = \max(0, x)$$

$$Relu(x) = \begin{cases} 0 & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$$

5. Leaky Relu

$f(x)$

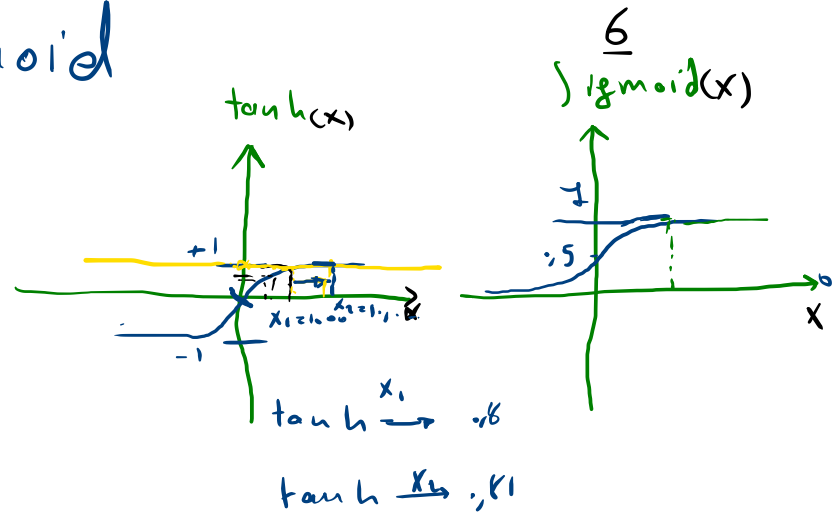$$f(x) = \begin{cases} x & x \geq 0 \\ \dfrac{0/x}{0/01} & x < 0 \end{cases}$$

x

tanh vs sigmoid

Similarity: α اشتقاق

diff $\longrightarrow$

tangh $\longrightarrow$ $\underset{\text{o}}{\overset{\text{mean}}{}}$

sigmoid $\longrightarrow$ ،5

tanh(x)

+1

-1

$X_1 = 1.000$ $x_2 = 1.1...$

$tanh \xrightarrow{x_1} .6$

$tanh \xrightarrow{x_{2}} .8$

$\frac{6}{\text{sigmoid}(x)}$

sigmoid(x)

1

.5

X

$0 \leq \sigma \leq 1 \longrightarrow$ تعسير اصلي

$-1 \leq tanh \leq 1 \longrightarrow X$

End