

1 nagy 2h 9/10. átk - péntek du.
sok kicsi a gyakorlatokon

kami + neur@digitus

Gyakorlatok: 4 órán 2h
utó: javító
hiányzás - 1-es

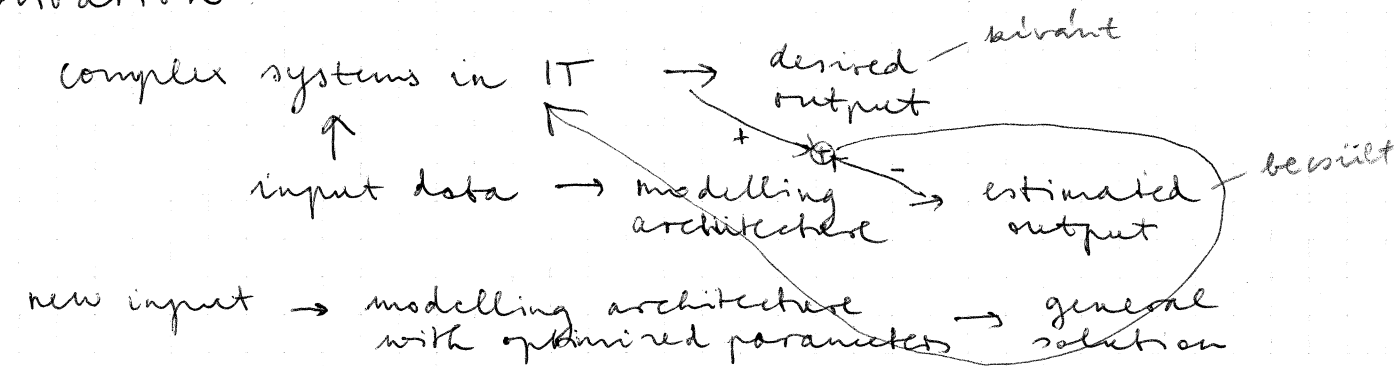
Vizsga: írásbeli + szóbeli
↓
4-es átlagok felett nincs

digitus/~kami/~nu

Neural networks

IX. 8.

Motivation:



Examples:

in (voice, video...) → IP network → QoS parameters
(average packet loss rate)...

users → GSM/GPRS
836 sys → multiuser
interface

stock prices → financial sys → optimal investment
for maximizing the return

How to model/optimize this systems?

Example: packet delay estimation

Problem: linear approximation isn't good if case
of not linear (polynomial) characteristic

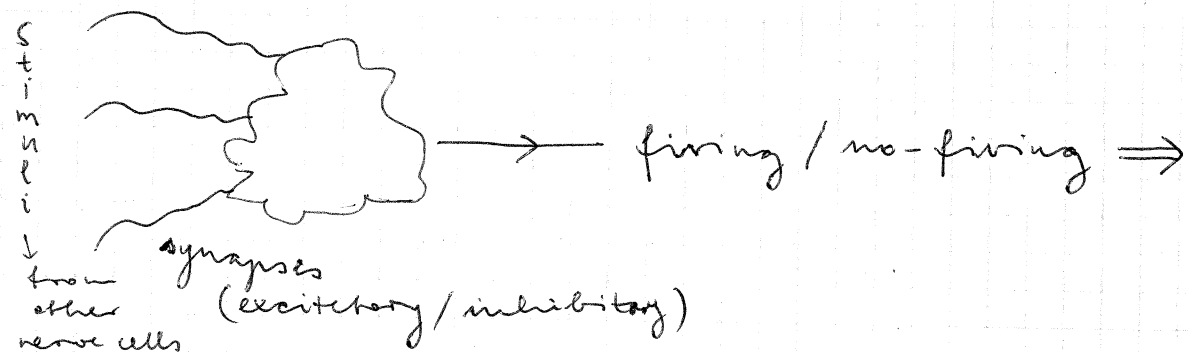
→ how to develop fast learning algorithm

A feladat: modellerés

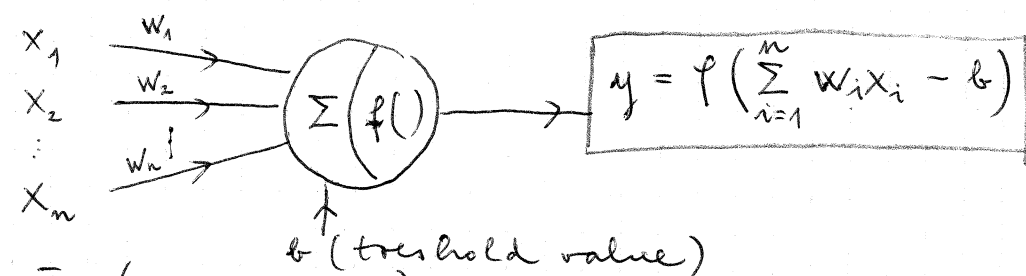
- reprezentáció
- tanulás / javítás
- általánosítás
- robustness - ellenőrzés
- modularizáció

} mammal brain

brain → neuron biological model → artificial neuron network (VLSI) → problem solving in IT



=> Artificial neuron:



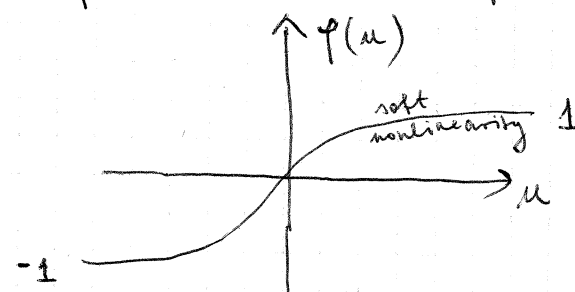
$$\bar{x} = (x_1 \ x_2 \ \dots \ x_n)$$

$\bar{w} = (w_1 \ w_2 \ \dots \ w_n)$ - weight vector (with free parameters)

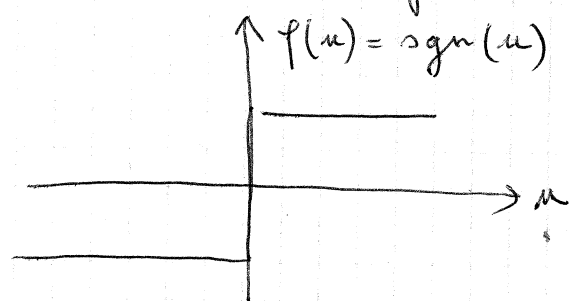
$|w_i| > 1$ excite - kissies

$|w_i| \leq 1$ inhibit - gattos

f : activation function



hard act. func.

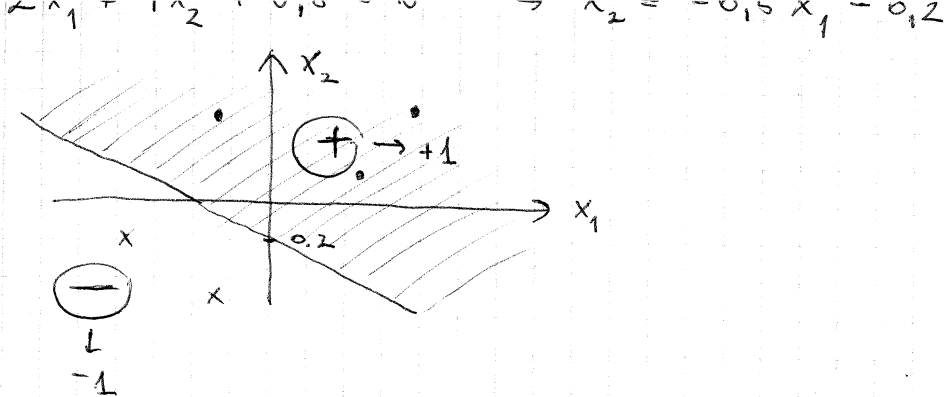


Why is it important to have an AN?

$$y = \text{sgn} \left\{ \sum_{i=1}^n w_i x_i - b \right\} = \text{sgn} \{ \bar{w}^T \bar{x} - b \} = \begin{cases} 1 & \text{if } \bar{w}^T \bar{x} - b \geq 0 \\ -1 & \text{if } \bar{w}^T \bar{x} - b < 0 \end{cases}$$

$$\bar{w}^T \bar{x} - b = 0 \quad \text{hyperplane}$$

$$y = \begin{cases} 1 & \text{if } 2x_1 + 4x_2 + 0.8 \geq 0 \\ -1 & \text{if } 2x_1 + 4x_2 + 0.8 < 0 \end{cases}$$

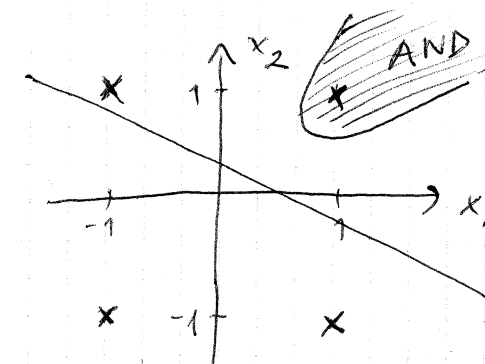


=> linear set separation!
for more variants too

Implementation of logical functions

AND

x_1	x_2	y
-1	-1	-1
-1	1	-1
1	-1	-1
1	1	1

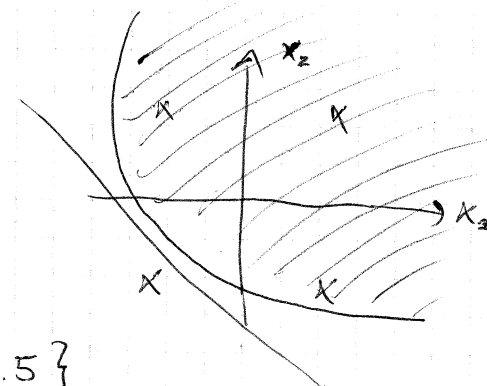


$$y = \text{sgn} \{ 1 \cdot x_1 + 1 \cdot x_2 - 1.5 \}$$

Ex.: $y = \text{sgn} \{ 1 \cdot x_1 + 1 \cdot x_2 + \dots + 1 \cdot x_7 - 6.5 \} \rightarrow \#D$

OR

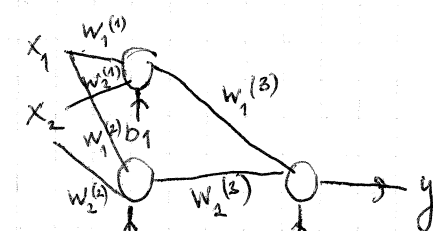
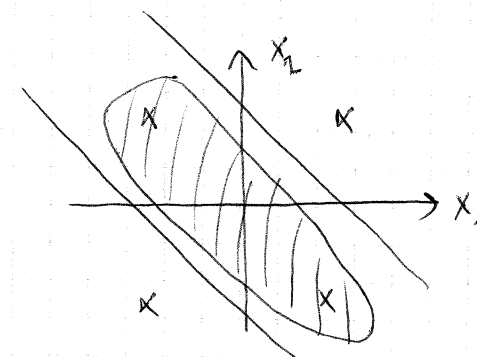
x_1	x_2	y
-1	-1	-1
1	-1	1
-1	1	1
1	1	1



$$y^{(OR)} = \text{sgn} \{ 1 \cdot x_1 + 1 \cdot x_2 + 1.5 \}$$

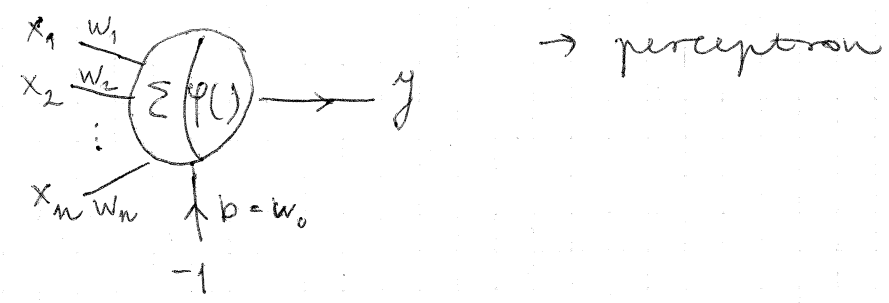
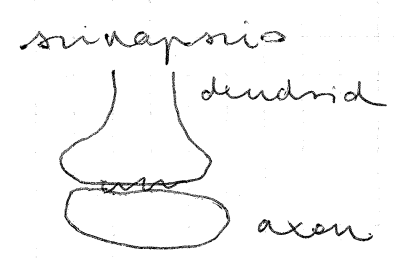
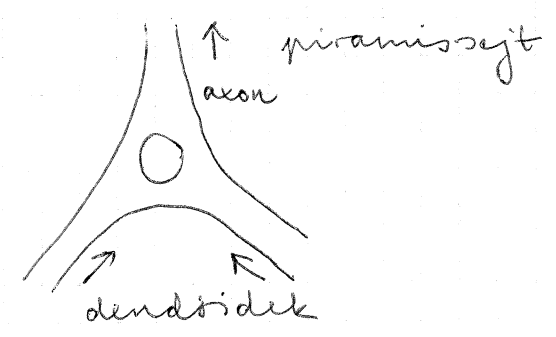
XOR

x_1	x_2	y
-1	-1	-1
1	-1	1
-1	1	1
1	1	-1



implement with more neurons (3)

$$y = \text{sgn} \left\{ w_1^{(3)} \text{sgn} (w_1^{(1)} x_1 + w_2^{(1)} x_2 - b_1) + w_2^{(3)} \text{sgn} (w_1^{(2)} x_1 + w_2^{(2)} x_2 - b_2) - b_3 \right\}$$

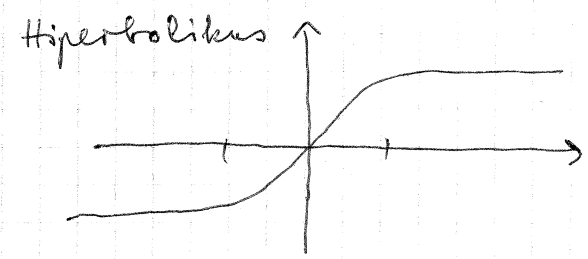
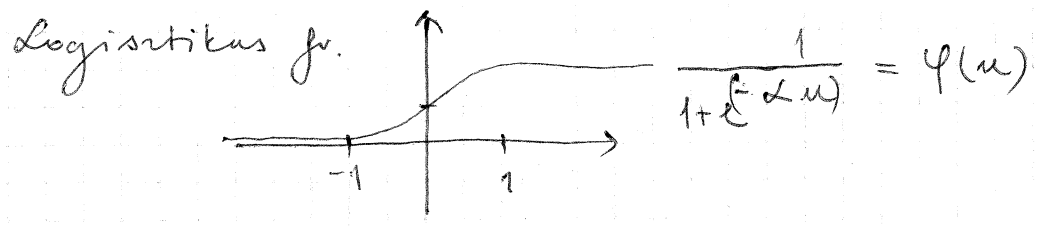
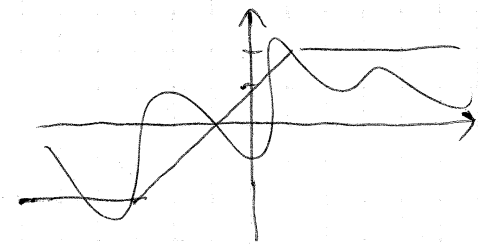
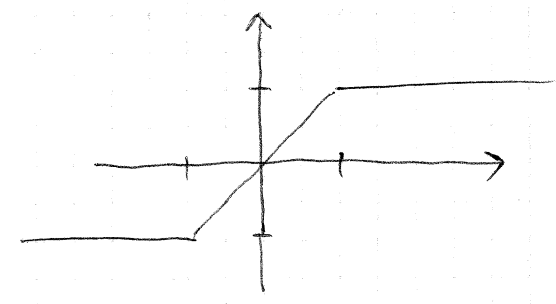
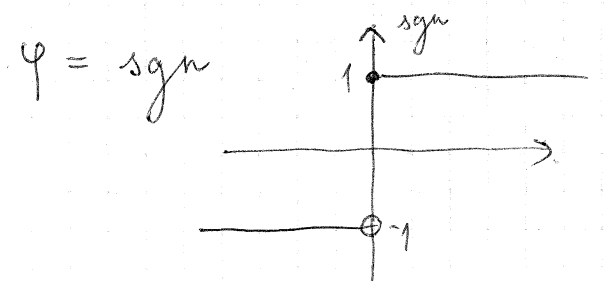


$$y = \varphi \left(\sum_{i=1}^n w_i x_i - \frac{b}{w_0} \right) =$$

$$\bar{w} = [w_0 \ w_1 \ \dots \ w_n]$$

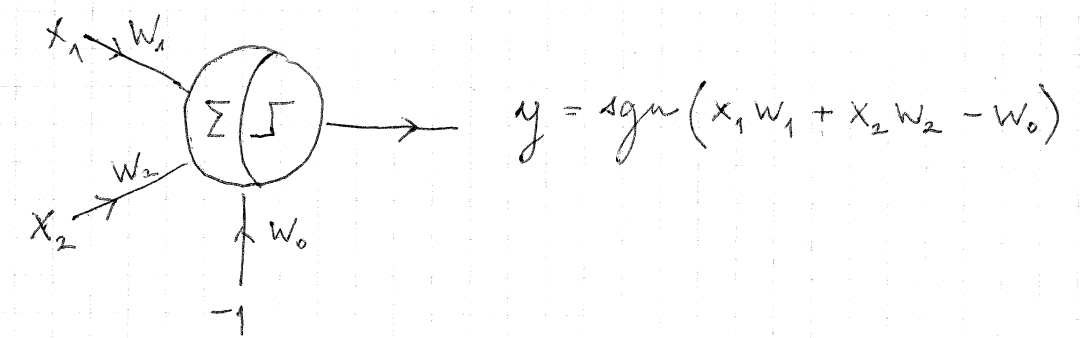
$$\bar{x} = [-1 \ x_1 \ \dots \ x_n]$$

$$= \varphi(\bar{w} \bar{x}^T)$$

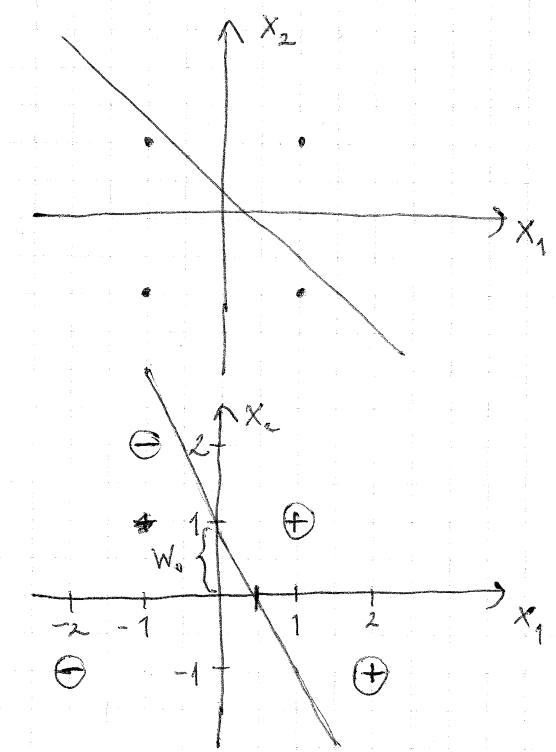


$$\varphi(u) = \frac{1 - e^{-2u}}{1 + e^{-2u}}$$

↳ hogy jött ki?



$$y = \text{sgn}(x_1 w_1 + x_2 w_2 - w_0)$$



egyes egyenlet: $x_1 w_1 + x_2 w_2 - w_0 = 0$

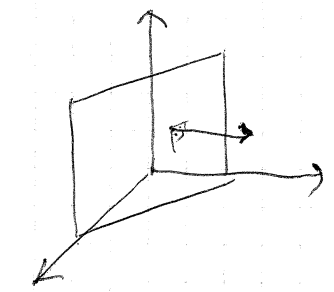
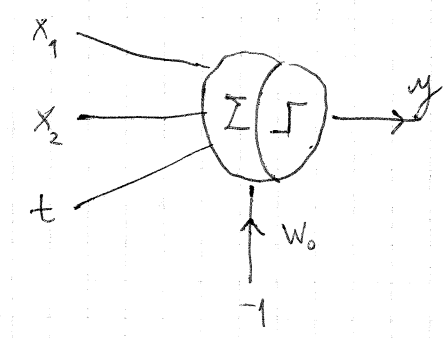
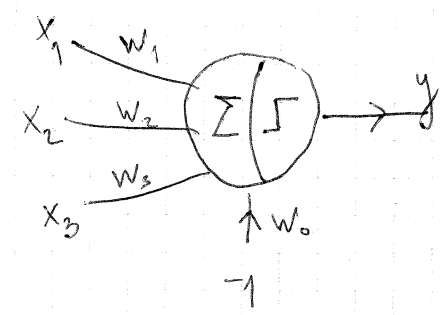
$$x_2 = \frac{w_0}{w_2} - x_1 \frac{w_1}{w_2}$$

$$x_2 = -2x_1 + 1$$

$$w_0 = 1 \Rightarrow w_2 = 1$$

$$w_1 = 2$$

$$\bar{w} = [1 \ 2 \ 1]$$



$$t = x_1^2$$

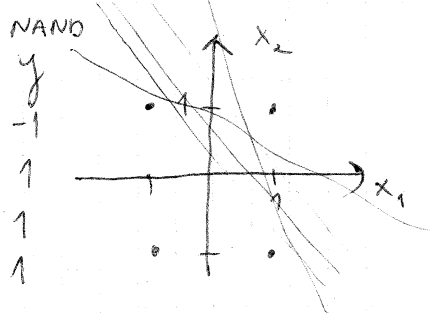
↳ Hf.: ez hogy fog kinélni? (görbe)

n bemenetre 2^{2^n} db logikai fv. írható fel.

$n = 2$

AND

x_1	x_2	y
1	1	1
1	-1	-1
-1	1	-1
-1	-1	-1



pl. $\bar{w} = [1,5 \ 1 \ 1]$ - AND

AND-ra: $[N-0,5 \ 1 \ 1 \dots]$ - AND

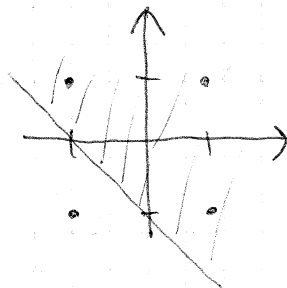
NAND $[-1,5 \ -1 \ -1]^T$ ✓

$[1,5 \ -1 \ 1]^T$ (X)

$\rightarrow$ ez változik, az egyenes egyenlete
 $w_1 x_1 + w_2 x_2 - w_0 = 0$ nem, ha hozzáruk -1-gyel

OR

x_1	x_2	y
1	1	1
1	-1	1
-1	1	1
-1	-1	-1

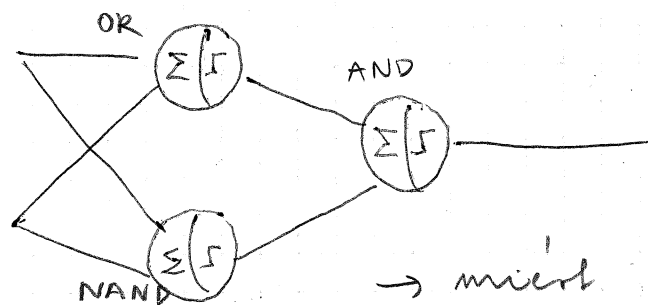
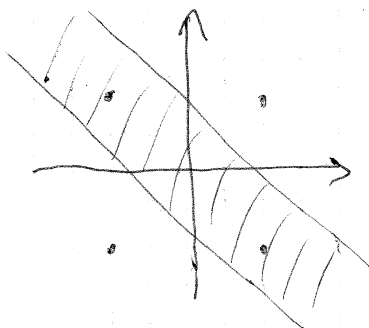


$\bar{w} = [-1,5 \ 1 \ 1]$

NOR

XOR

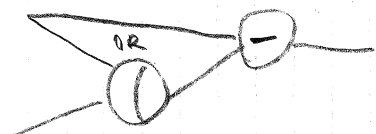
x_1	x_2	y
1	1	-1
1	-1	1
-1	1	1
-1	-1	-1



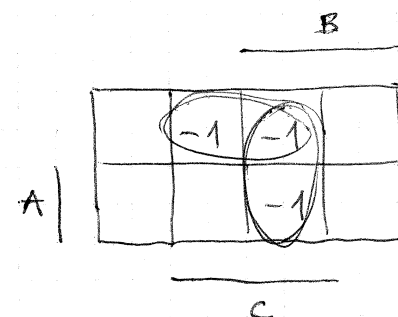
$\rightarrow$ multilayer perceptron

$\rightarrow$ miért

$\rightarrow$ hogy oldható meg legegyszerűbb neuronnal



A x_1	B x_2	C x_3	desire (kimenet)
1	1	1	1
1	1	-1	1
1	-1	1	1
-1	1	1	1
1	-1	-1	-1
-1	1	-1	-1
-1	-1	1	1
-1	-1	-1	-1



$\rightarrow$ mintának bevezése $\begin{pmatrix} \bullet = \text{AND} \\ + = \text{OR} \end{pmatrix}$
 $\rightarrow$ sík paramétereit

Matlab: Neural Network Toolbox

$\rightarrow$ tanulás
 $\rightarrow$ asszociációs hálózat

hami/nn

matlab work-be @ perceptron fajlba másol-
 ni - perceptron ontály

logisztikus fv. matlabfile-ba írása

