POOPĆENE DECIZIJSKE FUNKCIJE - AUDITORNE 2009/2010

- $\omega_1 = \{[0\ 2]^T, [-1\ -2]^T, [1\ ,-2]^T\}$
- $\omega_2 = \{[0\ 0]^T\}$

$w(1) = [0]$; $c = 1$

- POLINOM DRUGOG STUPNJA JE ZADAN

$$X^* = \begin{bmatrix} x_1^2 \\ x_1 x_2 \\ x_2^2 \\ x_1 \\ x_2 \\ 1 \end{bmatrix}$$

- PROJEKCIJA ULAZNOG PROSTORA

- $x_1 = [0\ 0\ 4\ 0\ 2\ 1]^T$.
- $x_2 = [1\ 2\ 4\ -1\ -2\ 1]^T$
- $x_3 = [1\ -2\ 4\ 1\ -2\ 1]^T$
- $x_4 = [0\ 0\ 0\ 0\ 0\ -1]^T$ # OVOG SMO POMNOŽILI SA -1 ZBOG ALGORITMA PERCEPTRONA JER PRIPADA KLASI ω_2

VRTIMO ALGORITAM PERCEPTRONA $\Rightarrow \vec{w}^T \vec{x} > 0$ MORA VRIJEDITI

$\vec{w}(1) = [0\ 0\ 0\ 0\ 0\ 0]^T$

$\vec{w}(1)^T \cdot [0\ 0\ 4\ 0\ 2\ 1]^T = 0 \Rightarrow$ KOREKCIJA!

$\vec{w}(2) = \vec{w}(1) + c \cdot \vec{x}_1 = [0\ 0\ 4\ 0\ 2\ 1]^T$

$\vec{w}(2)^T \cdot [1\ 2\ 4\ -1\ -2\ 1]^T = 13\ V \Rightarrow \vec{w}(3) = \vec{w}(2)$

$\vec{w}(3)^T \cdot [1\ -2\ 4\ 1\ -2\ 1]^T = 13\ V \Rightarrow \vec{w}(4) = \vec{w}(3)$

$\vec{w}(4)^T \cdot [0\ 0\ 0\ 0\ 0\ -1]^T = -1 \Rightarrow$ KOREKCIJA!

$\vec{w}(5) = \vec{w}(4) + c \cdot x_4 = [0\ 0\ 4\ 0\ 2\ 0]^T$

$\vec{w}(5) \cdot [0\ 0\ 4\ 0\ 2\ 1]^T = 20\ V \quad \vec{w}(6) = \vec{w}(5)$

$\vec{w}(6) \cdot [1\ 2\ 4\ -1\ -2\ 1]^T = 12\ V \quad \vec{w}(7) = \vec{w}(6)$

$\vec{w}(7) \cdot [1\ -2\ 4\ 1\ -2\ 1]^T = 12\ V \quad \vec{w}(8) = \vec{w}(6)$

$\vec{w}(8) \cdot [0\ 0\ 0\ 0\ 0\ -1]^T = 0 \Rightarrow$ KOREKCIJA

$\vec{w}(9) = \vec{w}(8) + c \cdot x_4 = [0\ 0\ 4\ 0\ 2\ -1]$

$\vec{w}(9) \cdot [\ 0\ \ 0\ \ 4\ \ 0\ \ 2\ \ 1\ ] = 19$ ✓ $\quad \vec{w}(10) = \vec{w}(9)$

$\vec{w}(10) \cdot [\ 1\ \ 2\ \ 4\ \ -1\ \ -2\ \ 1\ ] = 11$ ✓ $\quad \vec{w}(11) = \vec{w}(10)$

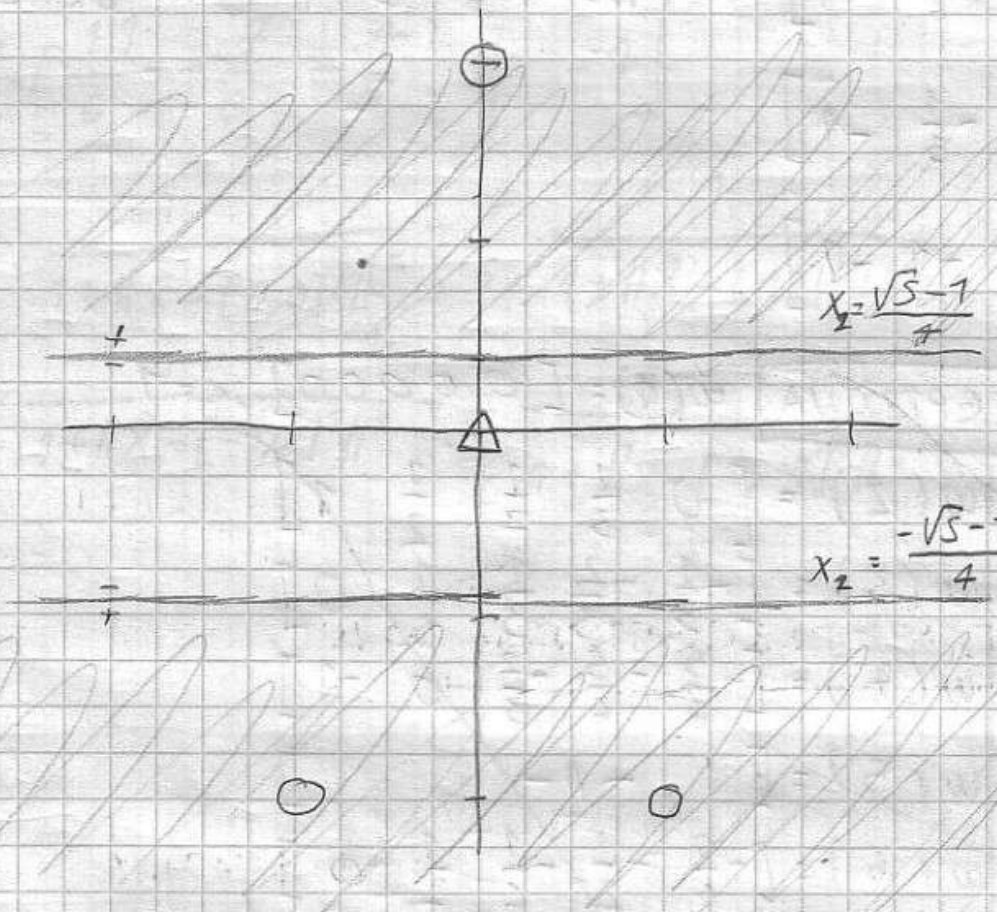
$\vec{w}(11) \cdot [\ 1\ \ -2\ \ 4\ \ 1\ \ -2\ \ 1\ ] = 11$ ✓ $\quad \vec{w}(12) = \vec{w}(11)$

$\vec{w}(12) \cdot [\ 0\ \ 0\ \ 0\ \ 0\ \ 0\ \ -1\ ] = 1$ ✓ $\quad$ - GOTOVO!

$$d(\vec{x}) = 4x_2^2 + 2x_2 - 1 = 0 \;//$$

$$x_{2\,1/2} = \frac{-2 \pm \sqrt{4+16}}{8} = \frac{-2 \pm 2\sqrt{5}}{8}$$

$$x_{21} = \frac{-\sqrt{5}-1}{4}; \quad x_{22} = \frac{\sqrt{5}-1}{4}$$



RADIJALNE BAZNE FUNKCIJE - AUDITORNE 2010/2011

$\omega_1 = \{[0\ 0]\}$ ○

$\omega_2 = \{[1\ 1], [-1\ 0], [0\ -1]\}$ △

$f(X) = \frac{1}{1 + \|\vec{x} - \vec{c_i}\|^2}$

$\vec{c_i} = \vec{x_i}$

- PRVO TRANSFORMIRAMO TOČKE $\vec{x_i}^* = [f(x_1, c_1)\ f(x, c_2) \dots f(x, c_N)$

$\vec{x_1}^* = [1\ \frac{1}{3}\ \frac{1}{2}\ \frac{1}{2}\ 1]$ ← ZADNJI ELEMENT JE PROŠIRENJE ZA POSTUPAK PERCEPTRONA 1

$\vec{x_2}^* = [-\frac{1}{3}\ -1\ -\frac{1}{6}\ -\frac{1}{6}\ -1]$ ← MNOŽIMO S -1 JER JE $\in \omega_2$

$\vec{x_3}^* = [-\frac{1}{2}\ -\frac{1}{6}\ -1\ -\frac{1}{3}\ -1]$

$\vec{x_4}^* = [-\frac{1}{2}\ -\frac{1}{6}\ -\frac{1}{3}\ -1\ -1]$

POSTUPAK PERCEPTRONA $w(1) = [0\ 0\ 0\ 0\ 0]$; $c = 1$

$w(1) \cdot x_1 = 0$	X	$w(2) = [0\ \frac{1}{3}\ \frac{1}{2}\ \frac{1}{2}\ 1]$
$w(2) \cdot x_2 = -\frac{3}{2}$	X	$w(3) = [-\frac{1}{3}\ -\frac{2}{3}\ \frac{1}{3}\ \frac{1}{3}\ 0]$
$w(3) \cdot x_3 = -\frac{1}{6}$	X	$w(4) = [-\frac{5}{6}\ -\frac{5}{6}\ -\frac{2}{3}\ 0\ -1]$
$w(4) \cdot x_4 = -1.77$	V	$w(5) = [$ —11— $]$
$w(5) \cdot x_1 = -1.6$	X	$w(6) = [-\frac{5}{6}\ -\frac{1}{2}\ -\frac{1}{6}\ \frac{1}{2}\ 0]$
$w(6) \cdot x_2 = 0.7$	V	$w(7) = [$ —11— $]$
$w(7) \cdot x_3 = 0.5$	V	$w(8) = [$ —11— $]$
$w(8) \cdot x_4 = 0.05$	V	$w(9) = [$ —11— $]$
$w(9) \cdot x_1 = 0$	X	$w(10) = [-\frac{5}{6}\ -\frac{1}{6}\ \frac{1}{3}\ 1\ 1]$
$w(10) \cdot x_2 = -0.7$	X	$w(11) = [-\frac{7}{6}\ -\frac{7}{6}\ \frac{1}{6}\ \frac{5}{6}\ 0]$
$w(11) \cdot x_3 = 0.3$	V	$w(12) = [$ —11— $]$
$w(12) \cdot x_4 = -0.1$	X	$w(13) = [-\frac{10}{6}\ -\frac{4}{3}\ -\frac{1}{6}\ -\frac{1}{6}\ -1]$
$w(13) \cdot x_1 = -1.6$	X	$w(14) = [-\frac{10}{6}\ -1\ \frac{1}{3}\ \frac{1}{3}\ 0]$
$w(14) \cdot x_2 = -1.44$	V	$w(15) = [$ —11— $]$
$w(15) \cdot x_3 = 0.56$	V	$w(16) = [$ —11— $]$

$w(16) \cdot x_4 = 0.56$	✓	$w(17) = [$ — " —
$w(17) \cdot x_1 = -0.5$	X	$w(18) = [-\frac{10}{6} \; -\frac{2}{3} \; \frac{5}{6} \; \frac{5}{6} \; 1]$
$w(18) \cdot x_2 = -0.06$	X	$w(19) = [-2 \; -\frac{10}{6} \; \frac{2}{3} \; \frac{2}{3} \; 0]$
$w(19) \cdot x_3 = 0.59$	✓	$w(20) = [$ — " — $]$
$w(20) \cdot x_4 = 0.39$	✓	$w(21) = [$ — " — $]$
$w(21) \cdot x_1 = 0.11$	✓	$w(22) = [$ — " — $]$
$w(22) \cdot x_2 = 2.11$	✓	$w(23) = [$ — " — $]$

KRIVO SAM IZRAČUNAO x_1^*, NEDA MI SE RASPISIVAT SVE PONOVO, RJEŠENJE JE (PROVJERENO S PYTHON SKRIPTO

$$\vec{w} = [\frac{11}{6} \; -\frac{7}{6} \; -\frac{4}{3} \; \frac{2}{3} \; -1]$$

$$d(\vec{x}) = \frac{11}{6} \cdot \frac{1}{1+\|\vec{x}-[0,0]^T\|^2} - \frac{7}{6} \cdot \frac{1}{1+\|\vec{x}-[1,1]^T\|^2}$$

$$- \frac{4}{3} \cdot \frac{1}{1+\|\vec{x}-[-1,0]^T\|^2} + \frac{2}{3} \cdot \frac{1}{1+\|x-[0,-1]^T\|^2} - 1 \; //$$

Za skup uzoraka $[2, 2]^T \in \omega_1$, $[-1, -1]^T \in \omega_1$, $[0, 0]^T \in \omega_2$ naći granicu između razreda, i to u **obliku polinoma drugog stupnja** koja se dobiva postupkom perceptrona sa stalnim prirastom. Neka je na početku **w** nul-vektor, a stopa učenja $c = 1$. Redoslijed pojavljivanja uzoraka neka bude onaj kojime su navedeni u zadatku.

POOPĆENE LINEARNE FJE - ISPIT 10.7.2006.

$\omega_1 = \{[-1\ -1]^T, [0\ 0]^T\}$ O

$\omega_2 = \{[2\ 2]^T\}$ Δ

$X^* = [x_1^2\ x_2^2\ x_1x_2\ x_1\ x_2\ 1]^T$ - POLINOM DRUGOG STUPNJA

-PROJEKCIJE ULAZNOG PROSTORA

$x_1 = [1\ 1\ 1\ -1\ -1\ 1]^T$

$x_2 = [0\ 0\ 0\ 0\ 0\ 1]^T$

$x_3 = [-4\ -4\ -4\ -2\ -2\ -1]^T$ # IMAMO 2 RAZREDA PA MNOŽIMO OVOG SA -1 DA SI OLAKŠAMO ŽIVOT :)

$w(1) = [0\ 0\ 0\ 0\ 0\ 0]$; $c=1$

$w(1) \cdot x_1 = 0$ [X] $w(2) = [1\ 1\ 1\ -1\ -1\ 1]^T$

$w(2) \cdot x_2 = 1$ [V] $w(3) = w(2)$

$w(3) \cdot x_3 = -9$ [X] $w(4) = [-3\ -3\ -3\ -3\ -3\ 0]^T$

$w(4) \cdot x_1 = -3$ [X] $w(5) = [-2\ -2\ -2\ -4\ -4\ 1]^T$

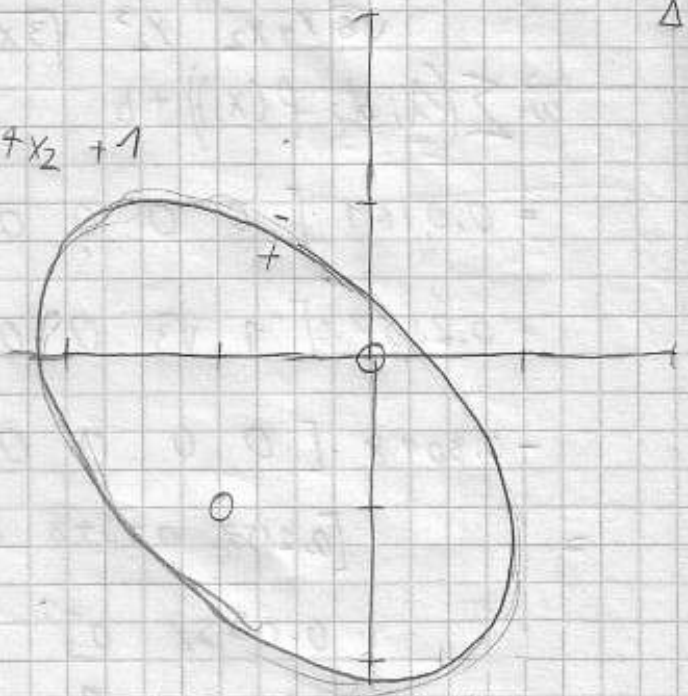
$w(5) \cdot x_2 = 1$ [V] $w(6) = w(5)$

$w(6) \cdot x_3 = 39$ [V] $w(7) = w(6)$

$w(7) \cdot x_1 = 3$ [V] ✓

Δ

$d = -2x_1^2 - 2x_2^2 - 2x_1x_2 - 4x_1 - 4x_2 + 1$



WOLFRAM ALPHA.COM PLOT

EDIT: FAK, SKUŽIO SAM DA SAM FULO KLASE UZORAKA ALI NEMA VEZE.

(3 boda) Zadani su uzorci iz tri razreda:

$\omega_1 = \{[0,0]^T\}$

$\omega_1 = \{[2,0]^T, [-1,1]^T\}$

$\omega_3 = \{[1,1]^T\}$

Postupkom preceptrona sa stalnim prirastom potrebno je naći decizijske funkciju za ove ozorke, i to u obliku **polinoma drugog stupnja**. Napišite prvu epohu algoritma (prvi prolaz kroz uzorke) algoritma koji nalazi ovakve decizijske funkcije. Neka su na početku svi težinski vektori nul-vektori, a konstanta $c = 1$.

POOPĆENE LINEARNE FJE - 2. MI - 2009/2010

$w_1 = \{[0\ 0]^T\}$ $w_2 = \{[2\ 0]^T, [-1\ 1]^T\}$ $w_3 = \{[1\ 1]^T\}$

PROJICIRAMO UZORKE → $x^* = [x_1^2\ x_2^2\ x_1x_2\ x_1\ x_2\ 1]^T$

$x_1 = [0\ 0\ 0\ 0\ 0\ 1]$

$x_2 = [4\ 0\ 0\ 2\ 0\ 1]$

$x_3 = [-1\ 1\ -1\ -1\ 1\ 1]$

$x_4 = [1\ 1\ 1\ 1\ 1\ 1]$

TERIRAMO $w_1 = w_2 = w_3 = [0]$; $c = 1$

(1) $x_1 = 0$ X $w_1(2) = [0\ 0\ 0\ 0\ 0\ 1]$

(1) $x_1 = 0$ X $w_2(2) = [0\ 0\ 0\ 0\ 0\ -1]$

(1) $x_1 = 0$ X $w_3(2) = [0\ 0\ 0\ 0\ 0\ -1]$

(2) $\cdot x_2 = 1$ X $w_1(3) = [-4\ 0\ 0\ -2\ 0\ 0]$

(2) $\cdot x_2 = -1$ X $w_2(3) = [4\ 0\ 0\ 2\ 0\ 0]$

(2) $\cdot x_2 = -1$ ✓ $w_3(3) = w_2(3)$

(3) $\cdot x_3 = -4$ ✓

(3) $\cdot x_3 = 2$ ✓

(3) $\cdot x_3 = -1$ ✓

(4) $\cdot x_4 = -6$ ✓ $w_1(4) = w_1(3)$

(4) $\cdot x_4 = 6$ X $w_2(4) = [3\ -1\ -1\ 1\ -1\ -1]$

(4) $\cdot x_4 = -1$ X $w_3(4) = [1\ 1\ 1\ 1\ 1\ 0]$

(5) $\cdot x_1 =$

(5) $\cdot x_1 =$

(5) $\cdot x_1 =$

I TAKO DALJE. KONAČNI w-OVI:

(6) $\cdot x_2 =$ $w_1 = [-4\ 0\ 0\ -2\ 0\ 1]$

(6) $\cdot x_2 =$ $w_2 = [3\ -1\ -3\ -1\ -1\ -1]$

(6) $\cdot x_2 =$ $w_3 = [-2\ 2\ 2\ 0\ 2\ -1]$

(7) $\cdot x_3 =$

(7) $\cdot x_3 =$

(7) $\cdot x_3 =$

(8) $\cdot x_4 =$

(8) $\cdot x_4 =$

(8) $\cdot x_4 =$

(9) $\cdot x_1 =$

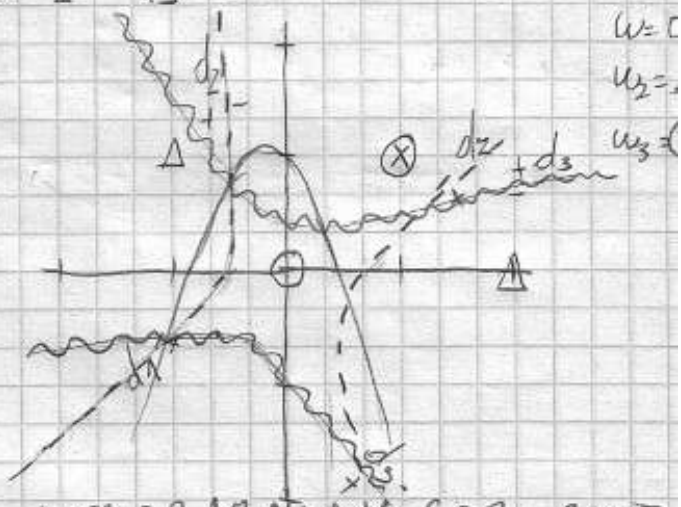
(9) $\cdot x_1 =$

(9) $\cdot x_1 =$

(10) $\cdot x_2 =$

(10) $\cdot x_2 =$

(10) $\cdot x_2 =$



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